ECONOMICS BACKGROUND DOCUMENT

PROPOSAL BY THE USEPA TO LIST WASTEWATERS AND WASTEWATER SLUDGES FROM CHLORINATED ALIPHATIC CHEMICAL MANUFACTURING PLANTS, AS RCRA HAZARDOUS WASTECODES K173, K174, K175: INDUSTRY PROFILE AND ESTIMATION OF INDUSTRY REGULATORY COMPLIANCE COSTS

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EXECUTIVE SUMMARY OF ESTIMATED INDUSTRY COMPLIANCE COSTS

1999 PROPOSED RCRA LISTING REQUIREMENTS

CHLORINATED ALIPHATIC HYDROCARBON COMPOUNDS (CAHCs)

SUMMARY OF ESTIMATED INDUSTRY COMPLIANCE COSTS FOR THE RCRA LISTING PROPOSAL K173+K174+K175

WASTEWATER TREATMENT SLUDGES AND WASTEWATERS

AVERAGE ANNUAL EQUIVALENT TOTAL INDUSTRY COST

Item	Type of CAHC Facility Potentially Affected by the Proposed RCRA Listing Options	Nr. of affected CAHC mfg. facilities	Nr. of affected CAHC mfg. processes	Initial capital costs ($ lump-sum)	Recurring annual O&M costs ($/year)	Average annualized equivalent total cost	Discounted present value total cost
A. K174 + K175: SLUDGE LISTING ESTIMATED COSTS:							
A1	K174: EDC/VCM sludge	1	1	$0	$1,333,000		
A2	K175: VCM-A process w/mercury catalyst	1	1	$0	$209,000		
	Subtotal sludge costs=	2	2	$0	$1,542,000	**$1,542,000**	
B. K173: WASTEWATER LISTING ESTIMATED COSTS:							
B1	Tank fixed roof + valve		9 tanks	$1,084,600	$81,600		
B2	Tank roof vent + carbon control device		9 tanks	$150,900	$591,200		
B3	Tank "Subpart CC" ancillary costs*		9 tanks	$0	$23,700		
B4	Initial waste testing for dioxins		51 tanks	$84,500	$0		
B5	Annual waste retesting for dioxins		43 tanks	$0	$70,400		
	Subtotal wastewater costs=			$1,320,000	$766,900	**$812,900**	
C. SLUDGE + WASEWATER COSTS (column totals):				**$1,320,000**	**$2,309,000**		
	with -10% cost estimation uncertainty** =			$1,188,000	$2,078,100		
	with +30% cost estimation uncertainty** =			$1,716,000	$3,001,700		
D. AVERAGE ANNUAL EQUIVALENT (AAE) TOTAL COST (at alternative discount rates):							
	0.0%			$46,000		**$2,355,000**	$68,295,000
	3.0%			$69,000		$2,378,000	$45,630,000
	5.0%			$87,000		$2,396,000	$36,278,000
	7.0%			$108,000		**$2,417,000**	$29,675,000
	10.0%			$141,000		$2,450,000	$22,956,000

E. EXPLANATORY NOTES:

(a) * "Subpart CC" ancillary costs consist of recordkeeping, reporting, etc. (general RCRA administrative burden costs not included above).

(b) Average annualized equivalent (AAE) computed by amortizing initial capital cost assumed to occur in the base-year, over the following period-of-analysis (POA) number of years = 30

The average annualized equivalent (AAE) capital cost, is added to the future average annual O&M cost, to derive a total annualized cost.

(c) ** -10% to +30% cost estimation uncertainty range adopted from Association for Advancement of Cost Engineering RPN 18R-97, 1998.

(d) F:\USER\MEADS\PROJECTS\CHLORALP\ECONWORK\ALLCOSTS.WK4 OSW-EMRAD 07/29/99

REQUEST FOR PUBLIC COMMENTS, INFORMATION AND DATA PERTAINING TO THE DESIGN, ACCURACY, REPRESENTATIVENESS AND COMPLETENESS OF THIS ECONOMICS BACKGROUND DOCUMENT

1. STUDY DESIGN: Suggestions for modifications and improvements to the scope, methodology, and organization of this study (e.g. 30-year cost annualization period-of-analysis applied).

2. FACILITY UNIVERSE: Correct number and operating characteristics of CAHC manufacturing and any other types of facilities potentially affected by the RCRA listing proposal.

3. AFFECTED WASTES: Correct average annual quantities, types and industrial sources (origin) of potentially affected CAHC manufacturing wastes.

4. INDUSTRY PROFILE: Characterization of the role, functions and industrial organization associated with the production and use of CAHCs in the US economy.

5. BASELINE WASTE MANAGEMENT: Characterization of baseline (current) waste management practices associated with CAHC manufacturing wastes (both onsite and offsite practices), including the types and relative waste quantities managed, types of waste management units, costs of waste management ($/ton basis), waste comingling and segregation, etc. In particular, there is uncertainty in the Section 3007 survey data, about the applicable number and sizes of wastewater management tanks used by CAHC manufacturing facilities.

6. COMPLIANCE WASTE MANAGEMENT: Adaptation of CAHC manufacturing facilities to the RCRA listing proposal if finalized, such as changes in manufacturing plant & equipment, facility layout, production processes and methods, business arrangements, CAHC product mixes, etc. What are possible consequences to waste management facilities for meeting pH and sulfide landfill restrictions?

7. FACILITY PROCESS MODIFICATIONS: Identification and dollar value of lump-sum capital investment costs required (per industrial operating unit or facility).

8. UNIT COSTS: Overall representativeness of industrial waste management unit costs applied to affected CAHC manufacturing facilities, involving both non-hazardous and hazardous waste handling. In particular, (a) possible premium unit cost associated with "condominium" landfill cell segregation of K174 listed wastes to comply with pH conditions; and (b) uncertainty in effectiveness of RMERC treatment method and unit costs associated with the mercury-containing K175 listed wastes.

9. IMPACT BENCHMARKS: The appropriateness of the alternative company financial benchmarks (e.g. annual sales revenues, annual profits, capital expenditures, short-term credit) presented in this study, and of other benchmarks not presented, for purpose of providing measurement references relative to assessing the dollar magnitude of the estimated industry compliance costs.

10. SUPPORTING DATA: The data applied in this study are from sources published over a number of years, and for some key data elements, are more than five years old (e.g. during preparation of this study, the US Bureau of Census' 1997 Survey of Manufacturers data reports were not yet available, so this study relied on the 1992 Survey of Manufacturers for quantifying a number of industry-wide characterization elements).

11. OTHER CONSIDERATIONS: Any other comments pertaining to other aspects of this study, or to topics which have been omitted or are outside the scope of this study, if relevant to assessing industry costs and other financial and economic impacts of the listing proposal.

ECONOMICS BACKGROUND DOCUMENT: PROPOSAL BY THE USEPA TO LIST WASTEWATERS AND WASTEWATER SLUDGES FROM CHLORINATED ALIPHATIC CHEMICAL MANUFACTURING PLANTS, AS RCRA HAZARDOUS WASTECODES K173, K174, K175: INDUSTRY PROFILE AND ESTIMATION OF INDUSTRY COMPLIANCE COSTS

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ECONOMICS BACKGROUND DOCUMENT:

PROPOSAL BY THE USEPA TO LIST WASTEWATERS AND WASTEWATER SLUDGES FROM CHLORINATED ALIPHATIC CHEMICAL MANUFACTURING PLANTS, AS RCRA HAZARDOUS WASTECODES K173, K174, K175: INDUSTRY PROFILE AND ESTIMATION OF INDUSTRY COMPLIANCE COSTS

PREFACE: This document was prepared by staff of the Economics, Methods, and Risk Analysis Division (EMRAD) of the Office of Solid Waste (OSW), US Environmental Protection Agency (USEPA). This document presents the findings of an economic study, in support of the USEPA's RCRA hazardous waste listing proposal. The public is encouraged to provide comments and feedback to the USEPA -- during the designated public review period indicated in the Federal Register notice of the listing proposal -- on the design and contents of this study, including submitting any supplementary information that may improve the accuracy, representativeness, or comprehensiveness of the information and data presented. Public reviewers may submit comments in writing directly to the RCRA Docket during the review period designated in the Federal Register notice for the listing proposal (contact the RCRA Docket by phone at 800-424-9346, or via the Internet at http://www.epa.gov/epaoswer/osw/infoserv.htm#info for further instructions).

I. INTRODUCTION

I.A. What is the Purpose of this Background Document?

This document presents the methodology, data, analyses, and findings of an economic study which estimates **$2.1 to $3.1 million** in average annualized, ***potential national industry compliance costs*** associated with the proposal by the Office of Solid Waste (OSW) of the US Environmental Protection Agency (USEPA), to list certain chlorinated aliphatic hydrocarbon manufacturing wastewaters and wastewater sludges, as "hazardous" industrial wastecodes **K173, K174, K175**, under authority of Subtitle C of the Resource Conservation and Recovery Act (RCRA) of 1976.[1]

The Economics, Methods, and Risk Assessment Division (EMRAD) of the USEPA Office of Solid Waste (OSW) designed and conducted this economics study. This study constitutes one analytic component of the listing determination and decision-making documentation, and should be interpreted in conjunction with the other technical background documentation and materials identified in the Federal Register preamble to the announcement of the RCRA listing proposal.

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[1] For purpose of facilitating both public and scientific review, effort has been made in this report to present a balance between both general descriptive information and specialized technical information. Although the text of this report presents summary definitions of Federal laws and regulations, and of economic, statistical and other scientific concepts applied in this study, references and footnotes are also provided for readers interested in obtaining more in-depth information. One convenient source of additional information (general and technical) about RCRA is available to the public over USEPA's "RCRA Hotline", which may be contacted between 9:00am to 6:00pm EST by phoning 800-424-9346 (800-553-7672 for hearing impaired), or via computer Internet at http://www.epa.gov/epaoswer/hotline/index.htm). The USEPA also publishes informational and educational booklets, such as(a) Guide to Environmental Issues (EPA document no. 520/B-94-001, Sept 1996, 84pp.) which provides definitions and explanations of environmental laws, regulations, and technical terms and phrases, available by phone request from USEPA's "Public Information Center" 202-260-7751; and (b) RCRA Orientation Manual 1998 Edition, EPA report nr. 530-R-98-004, May 1998, pp., available from National Service Center for Environmental Publications at 800-490-9198, or via the Internet at http://www.epa.gov/epaoswer/general/orientat/index.htm. Other sources of information about the USEPA and RCRA in general, may be accessed via the Internet at http://www.epa.gov and http://www.epa.gov/rcraonline ,respectively.

I.B. What is the Scope of this Background Document?

The scope of the RCRA listing proposal, and consequently the scope of this economic study, are determined by the conditions of a 08 March 1989 US District Court ***Consent Decree*** (Civ. Nr. 89-0598, J. Lamberth, as amended pursuant to motions filed through 12 June 1997), between the Environmental Defense Fund, Inc. (plaintiff), and the USEPA (defendants), and the American Petroleum Institute, et al. (intervener-defendants). The consent decree requires (page 15, paragraph m) the USEPA to propose and promulgate a final listing determination for:

> "[W]astewaters and wastewater treatment sludges generated from the production of the chlorinated aliphatics specified in the F024 listing."

The "**F024 listing**" referenced in the consent decree is a prior RCRA industrial hazardous waste listing determination finalized by the USEPA on 11 December 1989 (effective date 11 June 1990). The F024 listing targeted the following ***five industrial attributes*** of chlorinated aliphatic manufacturing operations (Federal Register, Vol.54, Nr.236, pp.50968-50979, 11 Dec 1989):

- Manufacturing process: ***Free radical catalyzed process*** for manufacturing chlorinated aliphatic chemicals.
- Chlorinated products: The free radical process as used to manufacture ***25 different chlorinated aliphatic chemicals*** used in the economy as major commercial products.
- Chlorinated toxicants: 30 **chlorinated aliphatic chemical *toxicants of concern*** as constituents in waste, indicated as the co-basis for the hazardous listing.
- Organic toxicants: Three **non-chlorinated organic *toxicants of concern*** as constituents in waste, indicated as the co-basis for the hazardous listing.
- Waste categories: Four industrial ***waste categories*** (i.e. distillation residues, heavy ends, tars, reactor clean-out wastes).

In addition to the RCRA F024 listing, the USEPA also issued the RCRA F025 listing in the same final announcement with F024. **Listing F025** pertains to four different types of chlorinated aliphatic manufacturing wastes (condensed light ends, spent filters and filter aids, and spent dessicant wastes). Notably excluded from the listed waste categories of both F024 and F025 were wastewaters, wastewater treatment sludges, spent catalysts, and heavy ends, spent catalysts, steam stripper, bottoms, filter solids associated with the production of specific kinds of chlorinated aliphatic chemicals listed as other ("Kxxx" type) hazardous wastes by the USEPA.

Consequently, the current listing proposal only addresses the non-listed wastestreams identified in the F024 listing. For reasons explained in the preamble and the listing background document for the Federal Register announcement of the current listing proposal, a different subset of waste toxicants of concern are identified, than those listed in the F024 (and F025) listing determination.

Because of the fact that the consent decree pertaining to the current listing requirement references a prior 1989 listing involving the targeted industry sector, this economic study provides both (a) a historical context and overview of the RCRA program and the affected industry sector and class of chemicals, as a background and platform for analyzing the present listing proposal, and (b) specific analysis focused on the scope of the current listing proposal:

- ***General background information*** on the RCRA program and affected industry sector:
  - **Chapter I**: Describes the purpose, scope, and methodology of this document.
  - **Chapter II**: Background to the USEPA's RCRA industrial hazardous waste program and listings process.
  - **Chapter III**: Background to the chlorinated aliphatics manufacturing

industry, its relation to other industrial sectors both upstream and downstream in the material flow of the economy, and an overview of the different types and uses of CAHCs.
    - **Chapter IV**: Description of baseline waste management practices in potentially affected CAHC manufacturing facilities.

- ***Specific information*** on the estimated effects of the proposed listing options:
    - **Chapter V**: Estimates of potential industry compliance costs for the separable elements of the proposed listing options.
    - **Chapter VI**: Specific data and analysis provided to address the economic analysis requirements contained in Federal administrative requirements.

Some readers with prior knowledge of regulatory and economic analyses, the RCRA program, and the particular affected industry sector, may decide to skip the general background Chapters I, II, III, and IV, and proceed directly to the listing-specific Chapters V and VI.

The scope and contents of this "**Economics Background Document**" are designed to complement the scope, methodology and findings contained in two other background documents in support of this listing proposal: the "**Risk Analysis Background Document**", and the **"Listings Background Document**". Both are referenced in the Federal Register announcement for this listing proposal, and are available for public review and comment from the **RCRA Docket** (phone 800-424-9346, or request via the following website: http://www.epa.gov/epaoswer/osw/infoserv.htm#info).

I.C. Are There Any Special Conventions Applied in this Document?

The contents of this document, as a technical background document to the listing proposal, contain different types and levels of information and references, to facilitate review by at least four different anticipated audiences:

- General public review.
- Affected industry sector review.
- State, local, and tribal government review.
- Social scientific review.

In addition, an initial working draft of this document was circulated in 1999 for review within the USEPA Office of Solid Waste, and by the Office of Management and Budget (OMB). Consequently, OSW-EMRAD did not design the format and contents of this document to target or optimize the information for review by any single audience.

Comments are encouraged from all review audiences, during the designated review period indicated in the Federal Register announcement for the listing proposal. There is a 14-month period currently scheduled according to the Consent Decree (paragraph m, p.15, as amended 12 June 1997), between announcement of this proposal (**scheduled for 31 July 1999**), and publication of the final rule (i.e. rule promulgation), scheduled for **30 September 2000**.

The content and format of this document conforms to the following four writing methods recommended for "**plain language**"[2]:

- Section headings in the form of **boldface questions**.
- Itemized bullets and lists.
- Short sections and paragraphs.

[2] Interested readers may consult the National Partnership for Reinventing Government's website http://www.plainlanguage.gov for further information about plain language methods and applications.

• Key words and phrases accentuated with **boldface** or ***boldface italic font***.

OSW-EMRAD created this document as a computer software (wordprocessing) file, which is a format conducive for electronic distribution via the Internet e-mail. The original electronic format of this document also contains Internet hyperlink references to supporting information and data sources, which may become activated as direct Internet "hotlinks", by downloading and converting this document file into an appropriate computer software format and application.

Chapters in this document are designed as relatively self-contained units of data and information, so readers may initially jump to a particular chapter or section of interest, without having to read the entire document from front to back.

This report also adopts the convention of referring to the Resource Conservation and Recovery Act of 1976 ("**RCRA**"), instead of to the Solid Waste Disposal Act of 1965 (SWDA), which RCRA amended. The SWDA was the first Congressional law that specifically focused on improving solid waste disposal methods, and has been amended or supplemented with at least ten other Congressional amendments or statutes between 1965 and 1996, of which the 1976 RCRA, as an amendment to SWDA, substantially remodeled the Nation's solid waste management system and laid out the basic framework of the current hazardous waste management program. Consequently, the SWDA with all its amendments is now commonly referred to as "RCRA", which is the convention applied in this document.

I.D. What is the USEPA's Regulatory History Behind this RCRA Listing Proposal?

Chlorinated aliphatic hydrocarbon chemicals (**CAHCs**) entered into commerce in the US in the early 1920s, and as of 1994, OSW-EMRAD estimates using US International Trade Commission data (presented in Chapter III of this document), that over **34.5 billion pounds** (17.2 million short tons) of CAHCs were manufactured by **26 to 29 chemical plants** in the United States, located in the **nine states** of Kansas, Kentucky, Louisiana, Maryland, Michigan, New Jersey, Ohio, Texas, and West Virginia.

As of 1997, OSW-EMRAD estimates using Internet published annual capacity data for CAHC manufacturing facilities (also presented in Chapter III), that total US CAHC production has increased to over **38.8 billion pounds** (19.4 million short tons), with an estimated final market sales value of between **$4.3 to $6.7 billion** (as also estimated in Chapter III). Although OSW estimates that the number of US CAHC manufacturing facilities as of 1997-98 has decreased to 23.

CAHCs are a group of ***organic chemicals*** -- most of which are colorless liquids at room temperature -- primarily used as intermediate feedstocks for the production of polyvinyl chloride (PVC) plastics; CAHCs are also used directly in liquid form as various types of solvents, as intermediates for the production of other types of chemicals, and in assorted other commercial use categories.

The industrial chemical processes used to produce CAHCs result in the production of **waste by-products** which may take many physical and chemical forms as gases, liquids, and solids from the following industrial sources (EPA, 1984, p.5306):

• Process wastewaters
• Wastewater treatment sludges
• Spent reaction catalysts
• Spent process filters and filter aids
• Distillation residues
• Heavy ends and tars
• Reactor clean-out wastes
• Dessicant wastes

The USEPA[3] publicly began the RCRA listing process for CAHCs **20 years ago in 1979**, with the

[3] The USEPA is not the only US Federal Government agency which initiated regulatory rulemakings targeted at CAHCs. A Congressional Act which predates the 1976 RCRA is the Occupational Safety and Health Act of 1970, which authorized the US Department of Health, Education and Welfare to issue worker protection regulations. These occupational standards were designed to protect the health of employees in workplaces associated with the processing, manufacture, and use of hazardous chemicals. In carrying-out this authority, as early as 1976, the National Institute for Occupational Safety and Health

proposed listing of certain types of CAHC manufacturing wastes as hazardous waste under the authority of RCRA. As required under RCRA Section 3001(b)(1) "Identification and Listing [of Hazardous Waste]", the USEPA first proposed an initial list of RCRA hazardous solid wastes in 1978 (Federal Register, 18 Dec 1978), which did not include wastes generated by CAHC-related industrial processes, or CAHCs as solid waste constituents.

After publication of this first RCRA hazardous waste list in 1978, based on continuing review of available information[4] on hazardous wastes, the USEPA proposed to expand its initial 1978 RCRA list, with a supplemental listing of **16 wastestreams** generated in the production of chlorinated organic chemicals. The USEPA RCRA regulatory actions targeted at this manufacturing sector unfolded according to the following Federal Register announcement milestones (other studies completed and Federal Register notices issued under different USEPA authorities and offices, targeted at CAHCs and the CAHC manufacturing sector, are not listed below):

- **1979**: "Proposed Rule and Request for Comments" pertaining to distillation residues, heavy ends, tars, and reactor clean-out wastes from chlorinated aliphatic hydrocarbon manufacturing wastes, (Federal Register, Vol.44, 22 Aug 1979, p.49402).

- **1980**: "Rule and Request for Comments" pertaining to chlorinated aliphatic hydrocarbon manufacturing wastes, (Federal Register, Vol.45, 19 May 1980, p.33064).

- **1984**: "Interim Final Rule and Request for Comments" pertaining to distillation residues, heavy ends, tars, and reactor clean-out wastes from chlorinated aliphatic hydrocarbon manufacturing wastes listed as RCRA waste code F024 (Federal Register, Vol.49, No.29, 10 Feb 1984, pp.5306-5312).

- **1984**: "Proposed Rule and Request for Comments", (pertaining to light ends, spent filters and filter aids, and dessicants from chlorinated aliphatic hydrocarbon manufacturing wastes listed as RCRA waste code F025, (Federal Register, Vol.49, No.29, 10 Feb 1984, pp.5313-5315).

- **1989**: "Final Rule" pertaining to finalization of RCRA waste code F024, and amending the final F025 RCRA waste code, (Federal Register, Vol.54, No.236, 11 Dec 1989, pp.50968-50979).

I.E. How Was This Economics Study Designed?

As indicated above, this study has been designed to provide preliminary information to different audiences for purpose of review and comment on the listing proposal. Consequently, this study contains different levels of information on a variety of interrelated topics, from the general to the specific. As described below, this study addresses a specific analytic component within the

investigated whether to regulate the largest volume CAHC manufactured: ethylene dichloride, for which a 1978 NIOSH study estimated that approximately two million workers in 148,165 US workplaces in 45 industries were potentially exposed to ethylene dichloride, with some 200,000 of these workers estimated to receive continuous exposure in the workplace (NIOSH, 1978, pp.2,3.)

[4] Three of USEPA's earlier industrial waste studies (1979 & 1980), targeted specifically at the CAHC manufacturing sector are: (a) "Source Assessment: Chlorinated Hydrocarbons Manufacture", by Monsanto Research Corp for the USEPA's Industrial Environmental Research Laboratory, Research Triangle Park, report nr. EPA-600/2-79-019g, Aug 1979, 188pp.; (b) "Identification of Pollutants from Chlorination and Related Unit Processes", by Mitre Corp for USEPA's Office of Research & Development (IERL-Cincinnati), grant nr. R805620-01, project nr. 15810, Feb 1980, 112pp; and (c) "Preliminary Draft Report: Chlorinated Hydrocarbon Manufacture: An Overview", by Acurex Corp for USEPA's Effluent Guidelines Division, contract nr. 68-02-2567, TESC task nr. 4027, 29 Feb 1980, 222pp.

framework of the RCRA hazardous waste listing rulemaking process at the USEPA.

From a social scientific methodological standpoint, this study also applies particular types of analytic methodologies which constitute only a subset of all possible methodological options for conducting an economic study in support of a hazardous waste listing process in particular, or in supporting study of environmental topics in general. In particular, the scope, methodology and limitations of this study in conjunction with an industrial waste RCRA-listing proposal, relate to at least four different possible ***study frameworks***:

- Regulatory analysis framework
- Risk assessment framework
- Industrial ecology framework
- Economic assessment framework

The applicability and contribution of each framework to this study is described below.

I.E1. Study Methodology Within a Regulatory Analysis Framework

In relation to RCRA-listing criteria which are summarized in the next section below, the scope of the Risk Analysis Background Document represents the RCRA waste management characterization criterion, which is comprised of 11 hazard assessment and listing factors. In relation to these listing factors, this economic study addresses the eleventh listing factor: “Such other factors as may be appropriate” (40 CFR 261.11(3)(xi)). The applicability of the other ten RCRA hazard listing factors are discussed in the Risk Analysis Background Document accompanying this listing proposal.

In particular, this study extends the scope of the USEPA-OSW’s assessment of human health and environmental exposure risk associated with CAHCs manufacturing wastewaters, to include estimation of the cost for industry compliance with RCRA management and technical requirements under the proposed listing options. However, this study does not extend the risk analysis into a ***benefit-cost*** or ***cost effectiveness*** assessment, but it does make a contribution to the integration of different types of considerations -- (a) health and environmental risks, (b) technological aspects of waste management, and (c) affected sector financial considerations -- in the development of the proposed listing.

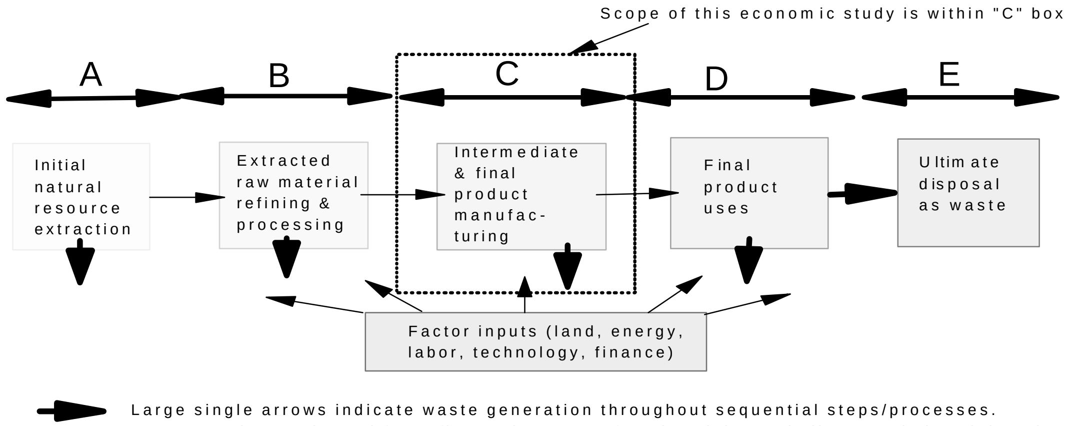
With respect to interpretation and application of the findings of this study for risk management and regulatory decision-making, the analytic objective of this study is not to provide an exact and complete economic analysis -- which is an unreasonable expectation relative to the state-of-art in social science and risk assessment tools -- but to provide “order-of-magnitude” and “approximating” indicators and measures of economic cost, for application in decision-making. For this reason, it is important to emphasize that although this study presents quantitative data and findings, and is presented as a separable and self-standing background document in support of the listing proposal, the information and results of this study are appropriately interpreted in conjunction with the information contained in the other background documents (as identified in the Federal Register announcement).

With respect to ***regulatory analysis***, there is also a set of specific Federal requirements concerning the application of economic analysis to regulatory development and regulatory actions. The US Congress, White House, and Office of Management and Budget (OMB) have established these Federal standards, which, for example, concern estimating the overall magnitude of anticipated impacts of regulatory actions, as well as specific impacts on targeted entities and sectors. Such applicable requirements concerning economic analysis, are within the scope of this study, and are described and addressed elsewhere in this document.

1.E.2. Study Methodology as an Industrial Ecology Framework

The potential for environmental and human health exposure risks to CAHCs may be characterized as relating to the complete **cycle of economic (commercial) activities** associated with these chemicals from “**cradle-to-grave**” (i.e. from “source” to “sink”). Such activities from an industrial ecological framework includes sequential (process flow) processes associated with six general categories of industrial activities depicted in Exhibit 1 below:

EXHIBIT 1:
Generalized Categories Within an Industrial Ecology Framework



Source: Boxes A-E above adapted from five major steps of "Industrial metabolism" or "industrial ecological" approach (e.g. Graedel & Allenby, 1995, pp.110-114, Anderberg, 1998, p.312).

This ***commercial cycle*** or ***materials flow*** perspective represents an ***industrial ecology*** framework, which includes the basic idea of analyzing the entire flow of materials such as chemical substances (i.e. ***industrial metabolism flow***, ***substance flow analysis***, ***anthropogenic flow***, ***mass balance***, or ***life-cycle assessment***) through society and the economy (i.e. the ***anthroposphere***).[5] From this perspective, in addition to chemical production, industrial processing and use, various other associated handling, storage and transportation and waste-related activities (e.g. treatment and disposal) may also be associated with each stage of the economic cycle involving CAHCs. Each activity and stage in this societal flow may also have an associated emission/release pathway for potential environmental and human health risks to the various physical and chemical forms of a material substance.

An industrial ecology framework may be expanded from a static (e.g. single year) and isolated flow (e.g. single chemical) approach, to include time-geographical (i.e. temporal-spatial) dimensions, for the purpose of illuminating and analyzing ***flow trajectories*** and inter-related processes and chemicals/materials in a ***process landscape*** framework (after Hägerstrand 1993). To this end, this economic study provides: (a) static single-year data “snapshots”, as well as (b) historical time-series data (e.g. spanning different time intervals over the period 1925-96), (c) time-series future scenarios (e.g. 2001-2030), and (d) descriptive information related to not only CAHC manufacturing, but also to upstream chemical inputs, CAHC processing, downstream use, and waste treatment/disposal, although not in a formalized and thorough industrial ecology or process landscape framework.

1.E.3. Study Methodology Within a Risk Assessment Framework

As described in academic literature as well as in governmental guidance, there are many types, purposes and frameworks to human, ecological and environmental risk analysis, risk assessment, and risk management. Three examples from US Federal Government sources are summarized below and reviewed for incorporation of, and reference to, economic analysis.

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[5] Two recent articles (among others) contribute to the developing field of industrial ecology with respect to chemical flow analysis -- building upon the conceptual work of Robert U. Ayers (1989) -- both of which are directly relevant to this economic study of chlorinated aliphatic hydrocarbons: (a) Kleijn et al. (1997) describe substance flow analysis theory and the results of such modeling applied to chlorine (and chlorinated hydrocarbons) in the Netherlands’ economy; and (b) using a petrochemical industry process network mathematical model containing 428 chemical processes and 224 chemical feedstocks, intermediates and final products, Chang & Allen (1997) present an analysis based on mass balance of material and energy flows, of chlorine use in the manufacturing of chlorinated intermediates.

• **Risk Framework Example #1**: For example, the **US Presidential/Congressional Commission** on Risk Assessment and Risk Management, assembled in May 1994 as directed by the 1990 Clean Air Act Amendments, released a two-volume report in 1997, detailing a "real-world public health and ecological context" framework for researching, characterizing, assessing, and reducing risk. The report was designed to provide an alternative to traditional risk assessment approaches such as: (a) chemical-specific, (b) medium-specific, and (c) risk-specific strategies. The Commission report provided the following **six methodological stages** to conducting risk assessment:

- **Stage 1**: Define the risk problem and place in a proper context (five steps).
- **Stage 2**: Analyze risks associated with the problem (potential for harm).
- **Stage 3**: Examine options to reduce risks (benefits, costs, impacts, feasibility).
- **Stage 4**: Make decisions regarding which options should be implemented.
- **Stage 5**: Take action to implement the decisions (involve stakeholders).
- **Stage 6**: Evaluate results by comparing actual **benefits/costs**, and reconsider.

Both Stages 3 and 6 of this Commission's risk assessment methodology involve economic analysis. Because of its focus on estimating potential industry compliance costs for the listing proposal, the scope of the present Economic Background Document may be considered to fall within **Stage 3** of this generalized risk assessment framework.

• **Risk Framework Example #2**: Prior to the above 1997 Commission report, the **USEPA's Science Policy Council** established in February 1995 its own agency "Guidance for Risk Characterization". The "**guiding principles**" of this guidance acknowledge that (Section I.B.2):

> "[T]he regulatory decision is usually not determined solely by the outcome of the risk assessment... For decision-makers, this means that societal considerations (e.g., costs and benefits) that, along with the risk assessment, shape the regulatory decision should be described as fully as the scientific information set forth in the risk characterization... Decision-makers should be able to expect, for example, the same level of rigor from the economic analysis as they receive from the risk analysis... Risk management decision involve numerous assumptions and uncertainties regarding technology, economics and social factors, which need to be explicitly identified for the decision-makers and the public."

However, although the USEPA's 1995 risk assessment principles acknowledge the role of economic analysis in risk decision-making, the Agency's March 1995 "Policy for Risk Characterization" which is based upon the Science Policy Council Guidance, defines the risk assessment process as consisting of the following **four steps**, none of which explicitly address or include economic analysis:

- **Step 1**: Hazard Identification
- **Step 2**: Dose-Response Evaluation
- **Step 3**: Exposure Assessment
- **Step 4**: Risk characterization and communication.

• **Risk Framework Example #3**: The **Office of Management and Budget** (OMB) also provides guidelines for Federal agency risk assessments, in the "general principles" section of its 11 January 1996 guidance for complying with the economic analysis requirements of the September 1993 Executive Order 12866. Although the benefit-cost requirements of EO12866 do not apply to the scope of this document (for reasons given in Chapter VI below), the OMB guidance (Section III.A.4(b)) also serves to illustrate an explicit link between risk assessment and economic analysis, in the form of three analyses:

- **Monetize risks**: Assign monetary values to risk probabilities.
- **Net benefits**: Estimate net benefits of risk change, by accounting for the

probability distribution of risk outcomes and future costs.

- **Risk premium**: Assess certainty equivalent value for regulatory options which reduce the overall variability of net benefits.
- **Risk distribution**: Assess incidence and distribution of monetized risk.

These three examples of risk assessment frameworks serve to illustrate that: (a) there are different institutional approaches to risk assessment, (b) economic analysis is not always explicitly defined and contained as a separable and/or integral element within the analytic scope of risk assessment frameworks, and (c) when explicitly included, economic analysis does not always serve the same purpose in the risk assessment framework. This Economic Background Document best fits within the "Stage 3" cost analysis of the first example risk assessment framework above.

I.E.4. Study Methodology Within an Economic Assessment Framework

This document does not represent a complete economic assessment, because its scope is limited to estimating industry compliance costs for the proposed listing options (if finalized in current form), and not to providing a broader assessment and comparison of the benefits and costs of the listing proposal (i.e. a "benefit-cost analysis"). As explained in Chapter VI of this document, a formal benefit-cost analysis is not required under Federal administrative requirements for regulatory analysis, because the estimated effects of this listing proposal on the national economy are not ***"economically significant***".

The ***potential benefits*** of this RCRA-listing proposal are described and quantified in the "Risk Analysis Background Document", but are not monetized in this economic study for comparison with estimated industry compliance costs. Furthermore, this study is limited in its ***quantitative orientation*** to estimating potential industry compliance costs, and only describes in a qualitative sense other types of potential economic effects and impacts of the proposed listing.

II. HAZARDOUS WASTE LISTING UNDER RCRA (GENERAL BACKGROUND)

This chapter presents ***descriptive background information*** about: (a) the industrial hazardous waste regulatory elements of USEPA's RCRA program, and (b) prior RCRA regulatory actions targeted at chlorinated aliphatic chemicals and associated manufacturing activities. Because of the fact that: (a) this background information is not integral to the estimation in this document of potential industry compliance costs for the proposed listing (which is the primary analytic purpose of this document), and (b) certain readers of this document may have prior knowledge about USEPA's RCRA program, readers may decide to skip this chapter.

II.A. What is "RCRA"?

In 1976, Congress directed the USEPA (which was founded in 1970) to establish and administer a national program for the safe management of municipal and industrial solid and hazardous waste. In brief, the three primary goals of RCRA are:

- To protect human health and the environment;
- To conserve energy and natural resources; and
- To reduce or eliminate the generation of hazardous waste as expeditiously as possible.

RCRA represents an amendment to legislation originated by Congress with the **1965 Solid Waste Disposal Act**, as amended by the **1970 Resource Recovery Act**. RCRA has been further amended with the **1984 Hazardous and Solid Waste Amendments Act**. The USEPA designed regulatory programs to implement RCRA. Under Subtitle C of RCRA, the USEPA sets mandatory procedures and requirements which must be followed by facilities in the United States that accumulate, transport, treat, store or dispose of "hazardous waste" (other sections (i.e. subtitles) of RCRA address non-hazardous waste).

These hazardous waste regulations are often referred to as a "cradle-to-grave" control system. In conjunction with the **1980 Comprehensive Environmental Response, Compensation, and Liability Act** (CERCLA) -- which is often referred to as "Superfund" after its 1986 amendments -- RCRA also operates to address problems of hazardous waste encountered at inactive or abandoned sites, and those resulting from spills that require emergency response. In addition to RCRA and CERCLA, Congress has granted the USEPA other statutory authorities for addressing hazardous waste management (such as the seven listed below), and for listing chemicals as hazardous (refer to the following website for descriptive information about these and 27 other (as of 1995) USEPA statutory authorities spanning from 1938 to 1990: http://www.epa.gov/epahome/laws.htm):

- Clean Air Act (1970; amended 1990)
- Federal Insecticide, Fungicide and Rodenticide Act (1972, amended 1988)
- Marine Protection, Research and Sanctuaries Act (1972)
- Safe Drinking Water Act (1974; amended 1986)
- Toxic Substances Control Act (1976)
- Clean Water Act (1977)
- Pollution Prevention Act (1990)

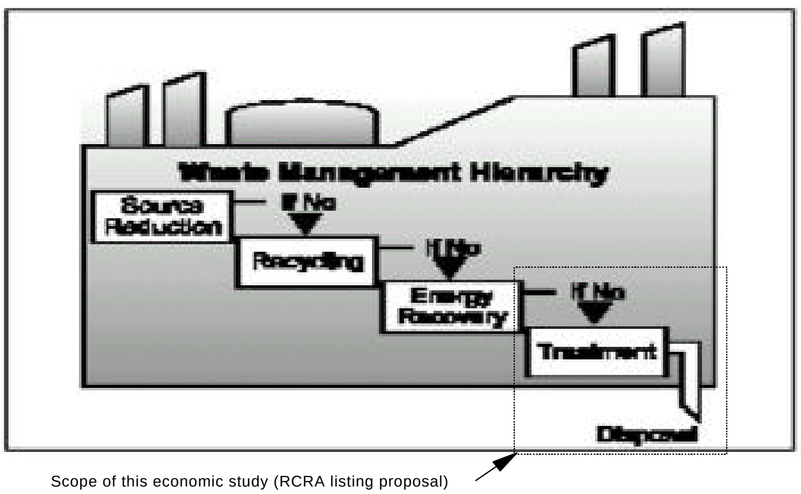
One of these other statutes -- the **1990 Pollution Prevention Act** (PPA) -- established as national policy that ***source reduction*** is the preferred approach to managing waste. Source reduction means preventing waste from being generated. The PPA also established as national policy a ***five-tiered hierarchy*** of waste management options, illustrated in Exhibit 2 below, for situations where source reduction cannot be implemented feasibly. RCRA hazardous waste management requirements correspond to the fourth (treatment) and fifth (disposal) tiers in this national policy hierarchy.

Hazardous waste regulations under the authority of RCRA are issued by the USEPA and published in the **Federal Register** (FR) for public review/comment, and once finalized, are compiled annually and bound into the **Code of Federal Regulations** (CFR). RCRA regulations appear in the CFR under Title 40, Parts 124 and 240-280; parts 260-268, 270, 271, 273, and 279 are devoted to hazardous waste management requirements for generators, for treatment, storage and disposal facilities, and for transporters. Title 40 of the CFR, which pertains to the USEPA's environmental regulations, may be accessed via the Internet at http://www.epa.gov/epahome/cfr40.htm .

Congress and the President set overall national direction for RCRA programs through amendments to the 1976 Act. More recently, the 1984 Hazardous and Solid Waste Amendments expanded the scope and requirements of RCRA. The USEPA Office of Solid Waste and Emergency Response (OSWER), translates this direction into operating programs by developing regulations. The USEPA clarifies its regulations through guidance documents and policy statements (which soon will be available to the public over the Internet). Because of the relatively broad scope of RCRA, and the evolving nature of hazardous waste management issues and practices, the Congress, President and the USEPA may enact additional and/or modified RCRA requirements in the future.

EXHIBIT 2:

RCRA Listings Within the US National Waste Management Policy Framework



II.B. What are RCRA Hazardous Waste "Listings"?

The regulatory framework established by Congress under RCRA Subtitle C was designed to protect human health and the environment from the effects of the improper management of industrial hazardous waste. Determining what is a "hazardous waste" was, and continues to be, a key task for implementation and revision of RCRA.

II.B.1. How Does RCRA Define "Hazardous" Wastes?

Only ***solid wastes*** may be potentially classified by the USEPA under RCRA has ***"hazardous" wastes***. USEPA defines solid wastes (40 CFR Part 261.2) as any discarded material (i.e. solids, semisolids, liquids or contained gases) which meets one or more of the following three criteria:

- **Abandoned**: Disposed of, burned/incinerated, or accumulated, stored, or treated before or in lieu of being abandoned or incinerated.
- **Recycled**: Accumulated, stored, treated before recycling, if used in a manner constituting disposal, burned for energy recovery, reclaimed, or accumulated speculatively.
- **Inherently waste-like**.

In Subtitle C Section 3001 of RCRA, Congress directed the USEPA to identify and list particular industrial wastes as "***hazardous***" to be subject to the waste management requirements of RCRA. According to the Chemical Manufacturers Association (CMA, 1997, p.7), the universe of potential hazardous wastes is large and diverse. As of the mid-1990s over **70,000 chemicals** are manufactured by the US chemical industry (which represents only 0.4% of the 18 million known chemicals registered by the American Chemical Society), and **100,000 chemicals** are involved in global economic activities. Hazardous wastes may arise from the manufacturing, processing, and end-use of chemicals in a variety of physical forms, substances, mixtures, and products. Furthermore, wastes may be potentially hazardous for different reasons.

Congress directed the USEPA to develop ***identification and listing criteria*** for hazardous wastes, based on toxicity, persistence, degradability in nature, potential for accumulation in tissue, and other related factors such as flammability, corrosiveness, and other hazardous characteristics. As codified in CFR Title 40 Part 261, the USEPA has developed the following **three primary criteria** for determining which municipal, industrial, mining and agricultural wastes to list as hazardous, requiring associated compliance with the equipment and procedural requirements as specified in the RCRA regulations:

(1) **Chemical hazard characteristics**: Wastes in the form of solid, liquid, semisolid, or contained gaseous discarded materials which exhibit: (1a) ignitability, (1b) corrosivity, (1c) reactivity, or (1d) leachability. (Note: this fourth characteristic is actually referred to as the "toxicity characteristic" in the RCRA regulations (40 CFR 261.24), but since it pertains to a small subset of only 40 possible waste constituents, and with regard to only the groundwater exposure pathway, it is referred in this economic study as "leachability");

(2) **Health hazard characteristics**: Has been found to be (2a) fatal to humans, or (2b) causes/contributes to serious irreversible or incapacitating reversible illness in humans in low doses (or in laboratory animal studies); and/or

(3) **Waste management characteristics**: Contains any substance which (3a) is shown in scientific studies to have toxic, carcinogenic, mutagenic or teratogenic effects on humans or other life forms (currently 480 such common name chemicals are listed by the USEPA in Appendix VIII of 40 CFR 261), and (3b) possesses a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed, as indicated by consideration of the following **11 *hazard factors***:

- Nature of toxicity
- Concentration
- Environment migration potential
- Persistence
- Degradation potential
- Ecosystem bioaccumulation
- Improper management scenarios
- Site/regional/national quantities of waste
- Nature/severity of health and environmental damage
- Actions taken by other governmental agencies
- Other appropriate factors.

The rationale for this particular RCRA listing proposal with respect to the above three criteria, is presented and explained in the "Risk Analysis Background Document" (referenced in the Federal Register announcement of this proposal), rather than explained in this document.

II.B.2. How Are Hazardous Wastes "Listed" Under RCRA?

As a result of applying the above hazardous waste identification and listing criteria, the USEPA has developed the following six listing "***hazard codes***" for designating and listing different wastes as hazardous under RCRA (as codified in the CFR Title 40 Part 261):

- Ignitable waste (I):
- Corrosive waste (C):
- Reactive waste (R):
- Leachable waste (E)
- Toxic waste (T)
- Acutely hazardous waste (H)

In addition to the six RCRA hazard codes which indicate the reason why a particular chemical is RCRA-listed, the USEPA assigns each listed waste with a unique number. USEPA's RCRA hazardous waste numbers are organized according to five RCRA-listing categories (i.e. RCRA "lists"); these lists are published in Part 261 of 40 CFR:

- **D-list**: Wastes which exhibit one or more of the four **chemical hazard characteristics** criteria: designated as D001 = ignitability; D002 = corrosivity; D003 = reactivity; and D004-D043 = mobility constituents; the USEPA has not compiled a universal list of chemicals designated as D001, D002 or D003 (40 CFR 261.20 to 261.24 "Subpart C").

- **F-list**: **Non-specific industrial source wastes**; i.e. generic wastes commonly produced by manufacturing and industrial processes; contains 28 wastes listed as F001-F039 as of 1998 (40 CFR 261.31).

- **K-list**: **Specific industrial source wastes**; i.e. wastes from specifically identified industries; contains 117 wastes listed as K001-K161 as of 1998 (40 CFR 261.32).

- **P-list**: Wastes in the form of specific discarded, off-specification, container residues and spill residues of commercial chemical products or manufacturing chemical intermediates determined by the USEPA to be **acutely hazardous**; contains 239 chemicals listed as P001-P205 as of 1998 (40 CFR 261.33).

- **U-list**: Wastes in the form of specific discarded, off-specification, container residues and spill residues of commercial chemical products or manufacturing chemical intermediates determined by the USEPA to be **toxic**; contains 612 chemicals listed as U001-U411 as of 1998 (40 CFR 261.33).

The current relationship between RCRA lists, to the listing criteria may be summarized as follows:

Waste Type	Waste Code	Waste Designation
Ignitable	I	D001 (no list available)
Corrosive	C	D002 (no list available)
Reactive	R	D003 (no list available)
Leachable	E	D004-D043 ("Table 1" list)
Toxic	T	F, K and U Lists
Acutely hazardous	H	F & P Lists

A particular chemical may appear on more than one RCRA list. There are also particular chemicals and wastes which are excluded from RCRA regulations. Wastes with a mixture of one or more listed hazardous wastes, and residues derived from the treatment of listed hazardous wastes are also hazardous wastes under RCRA (unless specifically exempt by regulation). Interested readers may consult USEPA's "RCRA Orientation Manual" (report nr. EPA530-R-98-004, May 1998) for more information about "RCRA" and "RCRA Listings".

II.C. Are There Any Prior RCRA Listings Associated With CAHCs or CAHC Manufacturing?

As of 1997, RCRA regulations already contain a total of **78 CAHC-related hazardous waste listings** on the five RCRA hazardous waste lists (D,F,K,U,P), as summarized below:[6]

1. **D-List**: Listed According to Chemical Hazard Characteristics by Leachability Hazard Code = E, relative to minimum regulatory concentrations (n = 9 listings involving CAHCs in 40 CFR 261.24):

D019: Carbon tetrachloride	(if > 0.5 mg/L).
D022: Chloroform	(if > 6.0 mg/L).
D028: 1,2-Dichloroethane	(if > 0.5 mg/L).
D029: 1,1-Dichloroethylene	(if > 0.7 mg/L).
D033: Hexachlorobutadiene	(if > 0.5 mg/L).
D034: Hexachloroethane	(if > 3.0 mg/L).
D039: Tetrachloroethylene	(if > 0.7 mg/L).
D040: Trichloroethylene	(if > 0.5 mg/L).
D043: Vinyl chloride	(if > 0.2 mg/L).

2. **F-List**: Listed According to Non-Specific Industrial Sources of Wastes by Toxic Hazard Code = T (n = 4 listings involving CAHCs in 40 CFR 261.31):

F001 & F002:	Spent halogenated solvents and still bottoms from the recovery of these spent solvents, including tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, 1,1,2-trichloroethane, and carbon tetrachloride.
F024 & F025:	Certain process wastes excluding wastewater from CAHC production.

3. **K-List**: Listed According to Specific Industrial Sources of Wastes by Toxic Hazard Code = T (n = 24 listings involving CAHCs in 40 CFR 261.32):

K009: Waste (distillation bottoms) from production of acetaldehyde from ethylene.
K010: Waste (distillation side cuts) from production of acetaldehyde from ethylene.
K016: Waste (heavy ends) from distillation in carbon tetrachloride production.
K017: Waste (heavy ends) from purification in the production of epichlorohydrin.
K018: Waste (heavy ends) from fractionation in ethyl chloride production.
K019: Waste (heavy ends) from distillation in ethylene dichloride production.
K020: Waste (heavy ends) from distillation of vinyl chloride/vinyl chloride monomer production.
K021: Waste (spent catalyst) from production of fluoromethane
K028: Waste (spent catalyst) from production of 1,1,1-trichloroethane.
K029: Waste (steam stripper) from production of 1,1,1-trichloroethane.
K030: Waste (bottoms/heavy ends) from production of trichloroethylene & perchloroethylene.
K032: Waste (treatment sludge) from the production of chlordane.
K033: Waste (wastewater/scrub water) from the chlorination of cyclopentadiene in chlordane production.
K034: Waste (filter solids) from the filtration of hexachlorocyclopentadiene in chlordane production.
K073: Waste (chlorinated hydrocarbons) from diaphragm cell anodes used in chlorine production.
K095: Waste (bottoms) from distillation in 1,1,1-trichloroethane production.
K096: Waste (heavy ends) from production of 1,1,1-trichloroethane.
K116: Waste (condensate) from solvent recovery in production of toluene diisocyanate via phosgenation.
K149: Waste (bottoms) from production of chlorinated toluenes and benzoyl chlorides.
K150: Waste (residuals) from gas recovery in production of chlorinated toluenes & benzoyl chlorides.
K151: Waste (treatment sludges) from production of chlorinated toluenes and benzoyl chlorides.
K156: Waste (organic) from production of carbamates and carbamoyl oximes.
K157: Waste (wastewaters) from production of carbamates and carbamoyl oximes.
K158: Waste (bag house dusts & solids) from production of carbamates and carbamoyl oximes.

4. **P-List**: Listed According to Names of Discarded/Off-specification Commercial Product Wastes by Acutely Hazardous Code = H (n = 6 listings involving CAHCs in 40 CFR 261.33):

P016: Dichloromethyl ether	P027: 3-Chloropropionitrile
P022: Carbonic dichloride	P033: Cyanogen chloride

[6] In addition to RCRA listings, the USEPA also maintains (in 40 CFR) other lists of chemicals for other statutory purposes, on which CAHCs also appear. For example, CAHCs appear on the USEPA lists developed for implementation of: (a) the Toxic Substances Control Act reporting requirements (e.g. 40 CFR 712.30 and 716.120) applicable to manufacturers, importers and processors of commercial chemical compounds; (b) the Federal Water Pollution Control Act effluent limitation guidelines for industrial process wastewater discharges from CAHCs manufacturers (40 CFR 414.70(d)); and (c) for designating hazardous substances and reportable quantities under the Federal Water Pollution Control Act (40 CFR 116.4 & 117.3); (d) water and human consumption concentration criteria for priority toxic pollutants for states not complying with the Clean Water Act (40 CFR 131.36); and (e) chemical concentration criterion and list of hazardous constituents as criteria for construction design, groundwater monitoring and corrective action for municipal solid waste landfill units (40 CFR 258.40 and 258 Appendices I and II, respectively).

P023: Chloroacetaldehyde
P118: Trichloromethanethiol

5. **U-List**: Listed According to Names of Discarded/Off-specification Commercial Product Wastes by Toxic Hazard Code = T (n = 35 listings involving CAHCs in 40 CFR 261.33):

U006: Acetyl chloride.
U024: Dichloromethoxy ethane
U025: Dichloroethyl ether
U027: Dichloroisopropyl ether
U034: Trichloroacetaldehyde
U042: 2-Chloroethyl vinyl ether
U043: Chloroethene (vinyl chloride)
U044: Trichloromethane (chloroform)
U045: Chloromethane (methyl chloride)
U046: Chloromethyl methyl ether
U057: Cyclohexanone
U066: 1,2-dibromo-3-chloropropane
U074: 1,4-dichloro-2-butene
U075: Dichlorodifluoromethane
U076: 1,1-dichloroethane
U077: 1,2-dichloroethane
U078: 1,1-dichloroethene
U079: 1,2-dichloroethene
U080: Dichloromethane (methylene chloride)
U083: 1,2-dichloropropane
U084: 1,3-dichloropropene
U121: Trichloromonofluoromethane
U128: Hexachlorobutadiene
U130: Hexachlorocyclopentadiene
U131: Hexachloroethane
U156: Methylchlorocarbonate
U184: Pentachloroethane
U208: 1,1,1,2-tetrachloroethane
U209: 1,1,2,2-tetrachloroethane
U210: Tetrachloroethene
U211: Tetrachloromethane (carbon tetrachloride)
U226: 1,1,1-trichloroethane (methyl chloroform)
U227: 1,1,2-trichloroethane
U228: Trichloroethene
U243: Hexachloropropene

In addition to appearing on the D, F, K, and U-Lists themselves (published in 40 CFR Parts 261.24, 261.31, 261.32, and 261.33) , the above-listed CAHC-related existing waste numbers also appear on other types of supplementary RCRA lists codified in the CFR, including:

- List of “Basis for Listing Hazardous Waste” (40 CFR 261 Appendix VII) which identifies the particular chemical constituents associated with each waste numbered on the F- and K-Lists.
- List of “Hazardous Constituents” (40 CFR 261 Appendix VIII) which identifies the common chemical names (cross-referenced to chemical abstracts name/number) associated with hazardous chemical constituents numbered as wastes on the U- and P-Lists.
- List of “Wastes Excluded from Non-Specific Sources” (40 CFR 261 Appendix IX Table 1) which identifies particular facilities in the US exempt to non-specific waste numbers and chemical constituents in wastes.
- List of “Wastes Excluded from Specific Sources” (40 CFR 261 Appendix IX Table 2) which identifies particular facilities in the US exempt to specific waste codes and chemical constituents in wastes.
- List of “Examples of Potentially Incompatible Waste” (40 CFR 264 Appendix V) which identifies particular classes of chemical constituents in wastes according to 12 groupings.
- List of “Groundwater Monitoring” (40 CFR 264 Appendix IX) which identifies practical quantitation limits (PQLs) in micrograms per liter for specific chemical constituents in wastes.
- Lists pertaining to burning RCRA-listed hazardous wastes in boilers or industrial furnaces:
    - List of “Reference Air Concentrations” (40 CFR 266 Appendix IV) which identifies RACs in micrograms per cubic meter for specific chemical constituents in wastes.
    - List of “Risk Specific Doses” (40 CFR 266 Appendix V) which identifies RsDs in micrograms per cubic meter for specific chemical constituents in wastes.
    - List of “Residue Concentration Limits (40 CFR 266 Appendix VII) which identifies RCLs in milligrams per kilogram for specific chemical constituents in wastes.
- Lists pertaining to land disposal prohibitions for RCRA-listed hazardous wastes:
    - List of “Schedule for Land Disposal Prohibition and Establishment of Treatment Standards” (40 CFR 268.10-.12) which identifies RCRA-listed hazardous wastes that will be evaluated for land disposal prohibition.
    - List of -”Prohibitions on Land Disposal” (40 CFR 268.31-.38) which identifies RCRA-listed hazardous wastes that are prohibited from land disposal.
    - List of “Treatment Standards for Hazardous Wastes” (40 CFR 268.40) which identifies wastewater and non-wastewater concentration levels by RCRA hazardous waste codes.
    - List of “Universal Treatment Standards” (40 CFR 268.48) which identifies wastewater and non-wastewater concentration levels for specific chemical constituents in wastes.
    - List of “Halogenated Organic Compounds Regulated Under Section 268.32" (40 CFR 268 Appendix III) which identifies specific chemical constituents which must be included in the calculation of hazardous waste concentrations for land disposal.

None of the existing RCRA-listed wastes summarized above include CAHC manufacturing wastewaters or wastewater sludges; these non-specific sources were specifically excluded from the prior rulemaking on CAHC manufacturing wastes (i.e. F024 & F025), because the USEPA believed it then had insufficient data to determine the hazardousness of wastewaters and wastewater sludges on a generic basis, and indicated these wastes would be evaluated for listing at a later date (Fed.Reg 5308, 10 Feb 1984). The present listing proposal constitutes the referenced "later date" evaluation.

As described in the Federal Register announcement, the proposed listing under evaluation in this document, is to add the following **three wastecodes**, which correspond to three types of wastes generated by CAHC manufacturers, to the RCRA **K-List** of hazardous wastes (at 40 CFR 261.32):

- **K173**: Wastewaters from the production of CAHCs (except WWs from vinyl chloride monomer (VCM) production which use a mercuric chloride catalyst, acetylene-based process, i.e. a "VCM-A" process).
- **K174**: Wastewater treatment sludges from the production of two specific types of CAHCs (i.e. ethylene dichloride (EDC) and vinyl chloride monomer (VCM)).
- **K175**: Wastewater treatment sludges from production of one type of CAHC (i.e. VCM), using a mercuric chloride catalyst, acetylene-based process (i.e. the "VCM-A" process).

III. OVERVIEW OF THE CAHC MANUFACTURING SECTOR IN THE UNITED STATES

III.A. What is the Significance of CAHCs in the US Economy?

Chlorinated aliphatic hydrocarbon chemicals (hereinafter referred to as "CAHCs") are a distinct subset of manmade (synthetic) organic chemicals, consisting in the late 1990s of **22 to 66 commercially-significant**[7], intermediate and final chemical products in the US economy. The high-end of this product range represents CAHCs which also contain:

- Other types of halogens (e.g. bromine, fluorine) in addition to chlorine,
- Other types of chemical elements and functional groups in addition to chlorine,
- Relatively small annual US production quantities, and/or
- Infrequent/irregular annual production.

For purpose of this document and the RCRA listing proposal, CAHCs are defined as:

> "Organic compounds characterized by straight-chain, branched-chain, or cyclic hydrocarbons containing one to five carbon atoms, with varying amounts and locations of chlorine substitution." (source: USEPA-OSW "Management Briefing" memo, January 1998, p.11)

"Hydrocarbons" are organic compounds (molecules) composed solely of the atoms hydrogen and carbon; "chlorinated" means that some of the hydrogen atoms attached to carbon atoms, have been replaced with chlorine atoms at one or more different positions; and "aliphatic" means that the chemical bonding between the carbon atoms are single, double, or triple covalent bonds (not aromatic bonds), and include the subgroups alkanes, alkenes or alkadienes, and alkynes, respectively.[8] The USEPA-OSW has limited the proposed listing to C_1-C_5 CAHCs for two reasons:

- Higher molecular weight C_{6+} CAHCs are not produced in significant quantities in the US.
- The manufacture of C_{6+} CAHCs typically does not produce large quantities of organic residuals and wastes (Federal Register, 50968, 11 Dec 1989).

CAHCs are largely man-made materials synthesized for commercial purposes. The replacement of halogens such as chlorine in a halogenated (e.g. chlorinated) aliphatic compound, by another chemical group, is regarded as one of the most important reactions in organic chemistry, because of the wide range of chemical product classes that may be produced using CAHCs as intermediates (Streitwieser, pp.127, 132). For industrial uses, chlorinated aliphatic hydrocarbons are used almost exclusively because of the comparatively high cost of bromine and iodine, however for small volume laboratory uses where cost is not as great a consideration, brominated aliphatic hydrocarbons are used preferentially because they are generally more reactive than chlorinated versions (Streitwieser,

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[7] The total number of types of commercial CAHCs in the US is uncertain; three sources contain the following estimates: (a) the US International Trade Commission identified US production of at least 29 different CAHCs in 1994 (see Exhibit 7 in this document); (b) the USEPA's Toxic Release Inventory contains 66 different CAHCs, part or all of which might be manufactured, processed or used in the US (see Attachment A to this document), and (c) CAHC manufacturer respondents to the 1997 USEPA-OSW RCRA Section 3007 industry survey, reported (CBI and non-CBI) a total of 22 different CAHCs (see Exhibit 16 in this document). The range suggested by these three sources is **22 to 66 commercial CAHCs** in the US as of the mid-1990s.

[8] Chlorine is one of five chemical elements grouped as "***halogens***" in the periodic table (i.e. group VIIA constituting fluorine, chlorine, bromine, iodine, and astatine, excluding hydrogen), which usually occur in free state as diatomic molecules. In addition to chlorine atoms, some chlorinated aliphatic hydrocarbon compounds (CAHCs) manufactured in the US may also contain other types of halogens, for example, bromochlorodifluoromethane, bromochloromethane, bromodifluoromethane, chlorofluoromethane, trichlorofluoromethane, etc. (USITC, 1992, p.3-21,3-22).

p.100).

III.B. What Are Commercial Applications for CAHCs (Downstream Economic Demand)?

As of 1997, OSW-EMRAD estimates based on installed annual production capacity, that over **38.8 billion pounds**[9] (19.4 million short tons) of CAHCs, with a final market sales value between **$4.3 to $6.7 billion**[10], were produced in the US.

CAHCs are important as starting materials (i.e. **chemical intermediates**) for the chemical synthesis of other compounds (primarily **plastics**), and are important as **solvents** in various applications, as described below. Overall demand for CAHCs in the US has grown an **average annual rate of 4.4%** over the 27-year period 1970-1996.

As of 1996, the production of three CAHCs -- ethylene dichloride, vinyl chloride, methyl chloride -- were on the list of the top-50 chemicals produced in the US (at ranks #12, #16, and #49, respectively). In that year relative to the largest volume chemical produced in the US -- sulfuric acid -- the production of these three top-50 CAHCs represented 20%, 17% and 1.2% relative volumes by weight (based on CMA, 1997, p.40). The two primary use categories, and a third "miscellaneous uses" category, are described below:

• **Plastic Resins**: The largest portion of CAHC production (>90% during the 1990s) is for use as an intermediate chemical building block for the production of polyvinyl chloride (PVC) plastics (and in lesser volumes for synthesis of other compounds). This use category has grown in the USA an average of 4.4% annually over the 27-year period 1970-1996. 1,2-dichloroethane (ethylene chloride) was reportedly the first CAHC to be synthesized in the year 1795, whereas the first reported commercial production of 1,2-dichloroethane in the US was in the year 1922 (WHO, 1979, p431), and is the largest quantity CAHC produced in the US, with annual capacity reported at 30.5 billion pounds. EDC and vinyl chloride monomer are consumed as plastic resins according to 11 plastic product demand categories consisting of both industrial users (i.e. processors, fabricators/finishers, and industrial end users), as well as consumer end products: (1) packaging (meat wrap, blister packs), (2) building/construction (pipe[11] & fittings, flooring, windows, panels, siding, swimming pool liners/covers, wall coverings), (3) housewares (blow-molded bottles, luggage), (4) transportation, (5) electric/electronic (wire & cable, lighting fixtures), (6) paints, (7) furniture (upholstery, lawn furniture), (8) appliances, (9) toys, (10) miscellaneous plastics, and (11) exports (Kline, 1980, pp.154-159; & CMA, 1997, p.20).

• **Solvents**: For applications in cleaning, degreasing, extractive, and dissolving carrier. This application category has grown in the USA an average of 1.0% over the 27-year period 1970-1996. Although the first known laboratory preparation of

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[9] A total of 47.95 billion pounds of installed annual US CAHC manufacturing capacity for three types of CAHCs is reported in the ChemExpo Internet website (http://www.chemexpo.com/news/ dated 16 Feb 1998), consisting of 30.53 billion lbs EDC + 16.63 billion lbs VCM + 0.79 billion lbs methyl chloride = 47.95 billion lbs. These three capacities do not include other types of CAHCs, which may be upward of 66 different commercial CAHCs in total. Applying the 1997 average capacity utilization rate of 81% for SIC codes 282 & 286 (see Exhibit F-3 in Attachment F to this document), produces an estimate of over **38.8 billion pounds** US CAHC production in 1997 (i.e. 47.95 billlion x 81%). It is important to note that because EDC is used captively for the production of VCM, not all CAHCs produced enter the chemical product sales market.

[10] OSW-EMRAD derived the **$4.3 billion low-end estimate** of final market sales value from the following data: $4.03 billion value for EDC/VCM from Exhibit F-2 of Attachment F to this document, plus $0.25 billion value for methyl chloride (i.e. (790 mill lbs 1997 annual capacity) x (81% 1997 capacity utilization rate) x ($0.385/lb unit price)). However, this low-end does not include the value of other types of CAHCs. OSW-EMRAD's derivation of the **$6.7 billion high-end estimate** of market value, is based on 1994 USITC quantity and price data for 13 CAHCs, displayed in Exhibit F-4 of Attachment F to this document.

[11] In the 1970s, plastic pipe has been one of the fastest growing end uses for any chemical, with plastic pipe production increasing at an annual rate of 14 percent (Kline, 1980, p.154).

CAHCs dates back to the early 1800s, the earliest commercial production for use as a solvent was carbon tetrachloride in 1907 (WHO, 1979, p.33). Solvent applications have included metal cleaning and vapor degreasing of engine parts in the automotive, railway and aircraft industries, high-purity cleaning applications in missile and electronics parts (e.g. electric motors and computer circuitry), formulation of adhesives and resins, textile dry cleaning, processing and finishing, drain cleaners, shoe polishes, spot cleaners and textile cleaning fluids, stain repellents, lubricant carrier, low-temperature heat transfer fluids, printing inks, paint and varnish removers, and as industrial chemical reaction process solvents.

• **Other Miscellaneous Uses**: Reported uses are numerous and have included (in random order): fumigants as agricultural and commodity pesticides and insecticides, ingredients in drugs and cosmetics, or as intermediates for synthesis of other chemicals for use as pesticides, insecticides, mothproofing agent, dyes, drugs and cosmetics, refrigerants, aerosol propellants, foaming agents, surgical anaesthetics/ analgesics/ disinfectants/ detergents, silicone polymers and rubber, and formulation of gasoline additives, although not all historical secondary uses are current because of changing market conditions, emergence of new substitutes, technological changes, toxic side-effects, and in many cases, or because of Federal regulatory actions.[12]

Exhibits 3 and 4 on the next pages, contain a data table and timeseries graphs, respectively, which display historical US production quantities for CAHC over the 17-year period 1980-96, for the two primary commercial use categories for CAHCs (plastics, solvents), and for total CAHC production including miscellaneous uses. During the mid-1990s (1992-96), **imports** have constituted a small percentage of CAHCs consumed in the US (about 270 million pounds or $<1.0\%$ of total US demand), while **exports** constituted about 4.0 billion pounds or 10% of total US demand (source: http://www.chemexpo.com/news/).

Prices for CAHCs in the mid-1990s reportedly ranged from **$0.10 to $2.05 per pound** (1994 USITC, & ChemExpo 1998 website), with the bulk of CAHCs, as represented by EDC and VCM, averaging $0.17 to $0.22 per pound.

[12] For example, as of 1976, The US Food and Drug Administration (FDA) listed approximately 1,900 human drug products that contained chloroform (i.e. trichloromethane), such as cough syrups, expectorants, antihistamines, liniments and decongestants; the FDA banned the use of chloroform as an ingredient (active or inactive) in human drug and cosmetic products as of 29 July 1976 (WHO, 1979, p.404).

EXHIBIT 3

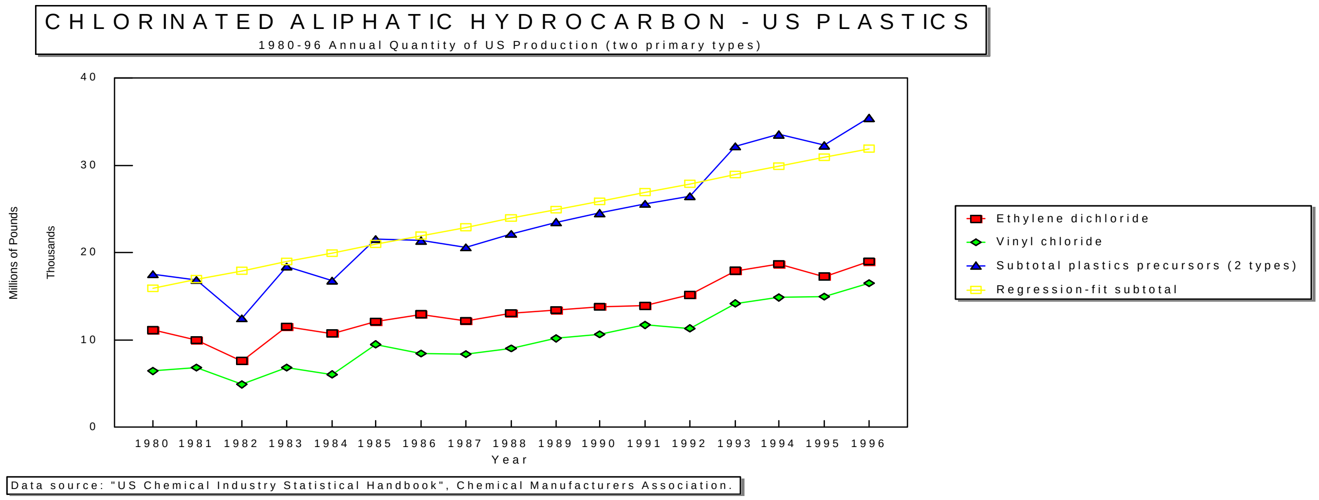
PRODUCTION OF CHLORINATED ALIPHATIC HYDROCARBON COMPOUNDS (CAHCs) IN THE UNITED STATES
(Million Pounds 1970-1996)

Name of Chlorinated		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Hydrocarbon Derivative	1970	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
A. Plastics precursors:																		
1 Ethylene dichloride	7460	11,108	9,974	7,619	11,506	10,710	12,101	12,940	12,197	13,028	13,383	13,850	13,920	15,150	17,947	18,699	17,263	18,950
2 Vinyl chloride	4040	6,466	6,874	4,902	6,875	6,085	9,463	8,439	8,402	9,058	10,135	10,624	11,695	11,307	14,220	14,818	14,977	16,450
Subtotal A (1+2) =	11,500	17,574	16,848	12,521	18,381	16,795	21,564	21,379	20,599	22,086	23,518	24,474	25,615	26,457	32,167	33,517	32,240	35,400
% annual change =		NR	-4.1%	-25.7%	46.8%	-8.6%	28.4%	-0.9%	-3.6%	7.2%	6.5%	4.1%	4.7%	3.3%	21.6%	4.2%	-3.8%	9.8%
% of total row C =	87%	90%	89%	88%	91%	89%	92%	91%	92%	92%	92%	93%	94%	93%	94%	94%	94%	94%
Effective annual rate of change 1970-1996 =																		**4.4%**
B. Solvents:																		
3 Chloroform	240	353	405	299	362	405	275	422	462	524	588	484	440	515	476	565	585	600
4 Methyl chloride	423	362	405	366	409	482	415	605	373	428	461	498	490	966	1,053	996	1,066	1,100
5 Methylene chloride	402	564	592	532	584	607	467	566	516	504	482	461	390	362	354	345	310	300
6 Perchloroethylene	707	765	691	585	547	573	678	414	473	498	481	372	240	245	271	247	260	275
Subtotal B (3+..+6) =	1,772	2,044	2,093	1,782	1,902	2,067	1,835	2,007	1,824	1,954	2,012	1,815	1,560	2,088	2,154	2,153	2,221	2,275
% annual change =		NR	2.4%	-14.9%	6.7%	8.7%	-11.2%	9.4%	-9.1%	7.1%	3.0%	-9.8%	-14.0%	33.8%	3.2%	-0.0%	3.2%	2.4%
% of total row C =	13%	10%	11%	12%	9%	11%	8%	9%	8%	8%	8%	7%	6%	7%	6%	6%	6%	6%
Effective annual rate of change 1970-1996 =																		**1.0%**
C. Total (A+B):	**13,272**	**19,618**	**18,941**	**14,303**	**20,283**	**18,862**	**23,399**	**23,386**	**22,423**	**24,040**	**25,530**	**26,289**	**27,175**	**28,545**	**34,321**	**35,670**	**34,461**	**37,675**
% annual change =		NA	-3.5%	-24.5%	41.8%	-7.0%	24.1%	-0.1%	-4.1%	7.2%	6.2%	3.0%	3.4%	5.0%	20.2%	3.9%	-3.4%	9.3%
Effective annual rate of change 1970-1996 =																		**4.1%**

Explanatory Notes:

(a) Source: Chemical Manufacturers Association, "US Chemical Industry Statistical Handbooks", 1992 & 1997.

(b) NR= Not relevant to annual change as first data point in series.


CHLORINATED ALIPHATIC HYDROCARBON - US PLASTICS
1980-96 Annual Quantity of US Production (two primary types)
Millions of Pounds
Thousands
0
10
20
30
40
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996
Year
Ethylene dichloride
Vinyl chloride
Subtotal plastics precursors (2 types)
Regression-fit subtotal
Data source: "US Chemical Industry Statistical Handbook", Chemical Manufacturers Association.

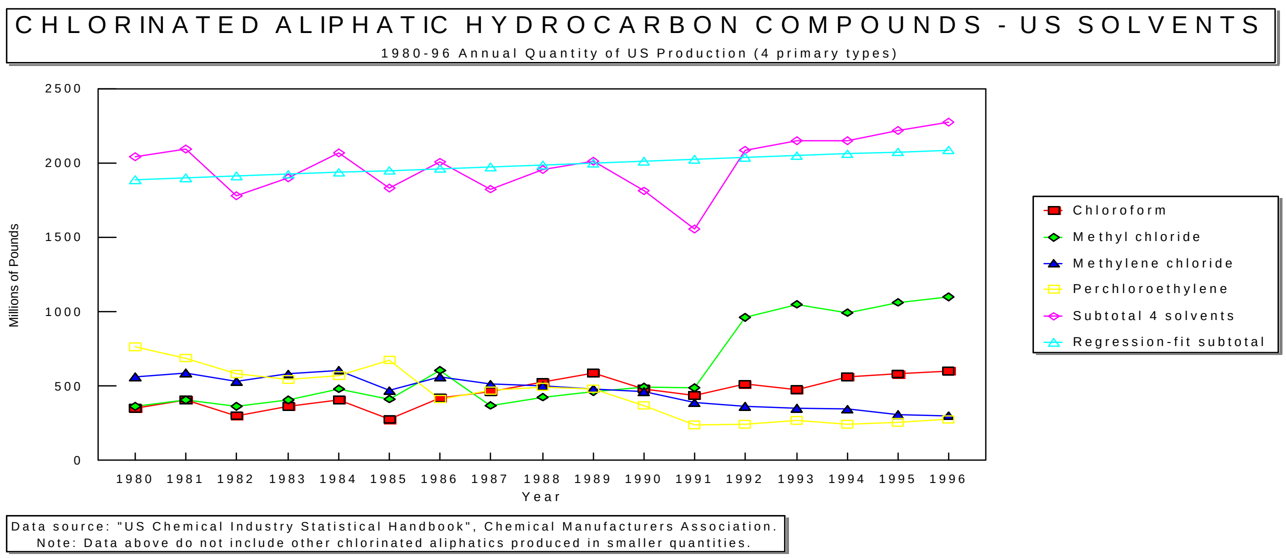
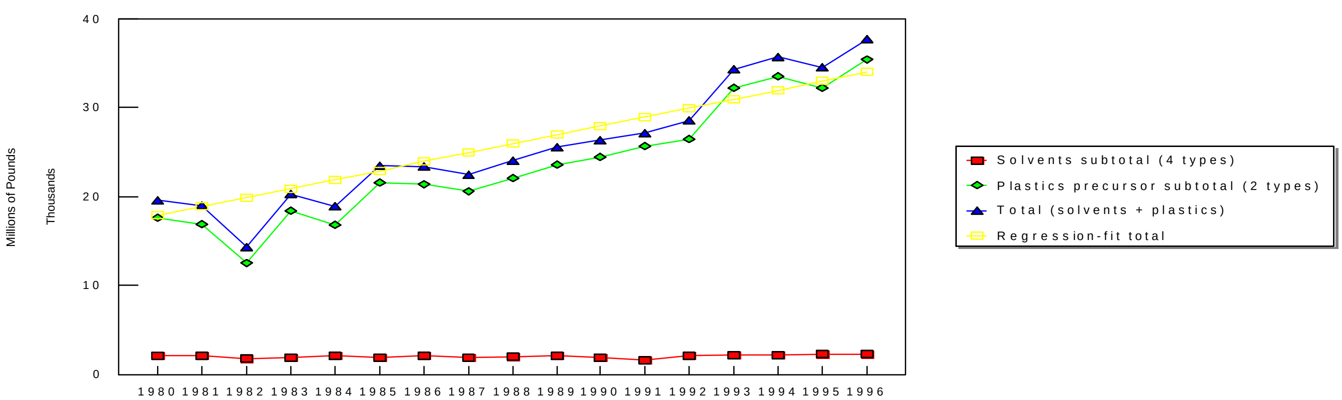

CHLORINATED ALIPHATIC HYDROCARBON COMPOUNDS - US SOLVENTS
1980-96 Annual Quantity of US Production (4 primary types)
Millions of Pounds
0
500
1000
1500
2000
2500
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996
Year
Chloroform
Methyl chloride
Methylene chloride
Perchloroethylene
Subtotal 4 solvents
Regression-fit subtotal
Data source: "US Chemical Industry Statistical Handbook", Chemical Manufacturers Association.
Note: Data above do not include other chlorinated aliphatics produced in smaller quantities.

EXHIBIT 4

CHLORINATED ALIPHATIC HYDROCARBON COMPOUNDS - US TOTAL

1980-96 Annual Quantity of US Production (Solvents & Plastics Precursors)



Data source: "US Chemical Industry Statistical Handbook", Chemical Manufactuers Association.
Note: Production total data above do not include other chlorinated aliphatics produced in smaller quantities.

III.C. <u>How Does US CAHC Production Compare to Global CAHC Production</u>?

Because of the fact that PVC production represents about 95% of total CAHC consumption in the US, PVC production data in itself constitutes an approximating or "proxy" measure of CAHC production, which may be compared to the available global PVC production data, as displayed below in Exhibits 5 & 6. Global PVC production (**39 countries**) has grown an average annual rate of 5.23% over the 16-year period 1982-1997, with US share of global production averaging about **71%** during this period.

EXHIBITS 5 & 6:

		A. GLOBAL PRODUCTION OF PVC:								B. USA PVC PRODUCTION:		
Item	Year	**Average of 3 data sources (1000 tons)**	Annual percent change	Data source#1: (1000 metric tons)	Data source#2: (10^9 kg)	Data source#2: Standard-ized units (1000 m.tons)	Data source#3: (1000 metric tons)	Data source#3: Nr. of countries producing	Average of 3 data sources (1000 m.tons)	Data source#4: (mill.lbs)	Data source#4: standardize d units (1000 tons)	**USA share as % of global prod-uction**
1	1982	**11,225.0**		10,181.1					10,181.1	12,521	6,260.5	**56%**
2	1983	**12,162.5**	8.35%	11,031.4					11,031.4	18,381	9,190.5	**76%**
3	1984	**13,348.7**	9.75%	12,112.6			12,102.0		12,107.3	16,795	8,397.5	**63%**
4	1985	**13,431.6**	0.62%	12,177.9			12,187.0		12,182.5	21,564	10,782.0	**80%**
5	1986	**13,978.3**	4.07%	12,672.7			12,684.0		12,678.4	21,379	10,689.5	**76%**
6	1987	**14,904.9**	6.63%	13,519.4			13,518.0		13,518.7	20,599	10,299.5	**69%**
7	1988	**16,917.3**	13.50%	14,522.0	17.0	17,000.0	14,510.0		15,344.0	22,086	11,043.0	**65%**
8	1989	**17,473.6**	3.29%	15,147.8	17.3	17,300.0	15,098.0		15,848.6	23,518	11,759.0	**67%**
9	1990	**17,461.9**	-0.07%	15,250.9	17.5	17,500.0	14,763.0		15,838.0	24,474	12,237.0	**70%**
10	1991	**17,207.4**	-1.46%	14,869.3	17.4	17,400.0	14,552.0		15,607.1	25,615	12,807.5	**74%**
11	1992	**18,046.9**	4.88%		18.0	18,000.0	14,737.0		16,368.5	26,457	13,228.5	**73%**
12	1993	**18,636.7**	3.27%		19.0	19,000.0	14,807.0	39	16,903.5	32,167	16,083.5	**86%**
13	1994	**22,050.7**	18.32%		20.0	20,000.0			20,000.0	33,517	16,758.5	**76%**
14	1995	**23,153.3**	5.00%		21.0	21,000.0			21,000.0	32,240	16,120.0	**70%**
15	1996	**24,807.1**	7.14%		22.5	22,500.0			22,500.0	35,400	17,700.0	**71%**
16	1997	**25,358.3**	2.22%		23.0	23,000.0			23,000.0	32,876	16,439.7	**65%**
Average annual growth			**5.23%**							Average annual share		**71%**

Explanatory Notes:

(a) Data sources:

#1: United Nations, "Industrial Statistics Yearbook 1991, Vol.II: Commodity Production Statistics", New York, 1993.

#2: Kirk-Othmer, "Encyclopedia of Chemical Technology", 4th ed., Vol.24, 1993, p.1037.

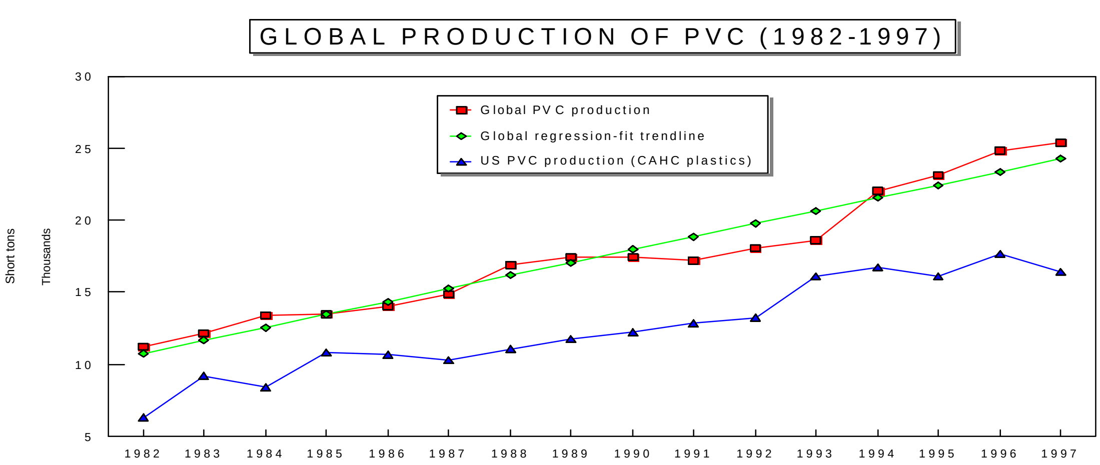
#3: United Nations, "Industrial Statistics Yearbook 1993, Vol.II: Commodity Production Statistics", New York, 1995.

#4: Chemical Manufacturers Association, "US Chemical Industry Statistical Handbook", 1997, pp.38,40.

(b) Ton = short ton = 2,000 lbs; Metric ton = 1,000 kilograms = 2,204 lbs; 1.0 kilogram (kg) = 2.204 lbs.

(c) = ton Co on: sho = me ton

m.ton metric ; nversi 1 . 0 rt tons 0.907 t r i c s.



III.D. What are the Upstream Chemical Inputs into CAHC Production?

The **hydrocarbon backbones** of CAHCs are natural products produced by living processes and the decomposition of animal and vegetable matter buried in the earth's crust, in the form of hydrocarbon mixtures known as petroleum and crude oil, which may be distilled to separate the constituents for use as basic feedstocks to the chemical industry. These hydrocarbon feedstocks are combined with chlorine (in assorted chemical forms depending on the industrial process used), to form CAHCs.

Chlorine is one of the basic raw materials of the chemical industry, constituting the ninth largest volume chemical produced in the United States (1996 = 12.6 million tons; CMA 1997, p.40), produced by electrolysis of salt water. Different physical and chemical forms of chlorine (e.g. diatomic gas or in compound form such as sulfuryl chloride or hydrochloric acid liquids; Streitweiser, p.83) may be used for the production of CAHCs. The demand for chlorine for the production of chemicals has grown tremendously, from constituting 17 percent of total US demand for chlorine in 1925, to 80 percent by the 1960s (Sconce, p.13).

III.E. What are the Physical and Chemical Forms of CAHCs?

CAHCs are usually **colorless liquids** at room temperature and are insoluble in water (however some CAHCs such as chloromethane are colorless gases at room temperature, while at least one CAHC, hexachloroethane, exists as colorless crystals at room temperature). CAHCs are consumed and used as both intermediate feedstocks as chemical building blocks, and in direct end-use product applications.

CAHCs, as with many other classes of organic compounds, may be named with both a common and a systematic nomenclature based on the 1892 International Union of Pure and Applied Chemistry (IUPAC) Geneva rules for naming alkanes (hydrocarbon compounds), which is based on naming chemicals according to the longest single carbon chain present in the compound. Exhibit 7 presents a list of 29 specific CAHCs reported by the US International Trade Commission[13] as manufactured in the US during 1994.

CAHCs may be produced at different levels of purity (e.g. reagent or analytic grade, technical, commercial (e.g. solvent grade), and pharmaceutical grades), and usually contain production ***impurities***, consisting of other by-product CAHCs (including isomers), other by-product chemicals, stabilizers, water, and metals. For example, a typical analysis of commercial grade vinyl chloride monomer (VCM) has been found to consist of 99%-99.9% VCM, with butadiene, 1,2-dichloroethane, 1,1-dichloroethane, hydrogen chloride, acetaldehyde, peroxides, sulfur, iron and water impurities (Albright, 1976, p.14); commercial dichloromethane (methylene chloride) may contain up to 1.0% methyl chloride, chloroform, 1,1-dichloroethane, and 1,2-dichloroethene as impurities (WHO, 1986, p.45). Some CAHCs are sold for commercial applications at low purity such as 1,3-dichloropropene, which in one product has been sold as a 55% mixture with production

[13] Since 1917, the US International Trade Commission (USITC) has compiled annual reports on the production and sale (domestic and foreign) of synthetic organic chemicals and the raw materials from which they are made. This service was terminated by Congress in 1995 (Fed.Reg, 28 Nov 1995, p.58639). The USITC sends questionnaires to domestic chemical manufacturing companies; In 1995 the final publication year, the USITC received questionnaires for this report from a total of 651 domestic chemical manufacturing companies. Production and sales data are presented in publicly-available annual reports only when there are three or more producers for a single chemical or chemical group. The production and sales data represent commodity quantities of undiluted chemical material (i.e. 95% or greater purity), excluding intermediate products which are formed in the manufacturing process but are not isolated from the chemical reaction system. CAHCs are listed in the USITC database under the Harmonized Tariff Schedule (HTS) numbers 29031 & 29032. In addition to chlorinated aliphatic (acyclic) hydrocarbons, the USITC database also includes brominated, fluorinated and iodinated aliphatic hydrocarbon compounds (HTS 29033 & 29034). The data in the list above are from extracted from the 76th annual USITC report Synthetic Organic Chemicals, Feb.1994.

process impurities of 1,2-dichloropropane and dichloropropene isomers[14] (WHO, 1986, p.114).

Commercially available technical and solvent grade CAHCs may have a purity of 90-95% and contain from 3-8% ***stabilizers*** to prevent the generation of hydrochloric acid, which may occur from reaction with water (hydrolysis). For example, chemical compounds used as stabilizers for 1,1,1-trichloroethane based degreasing solvents may include nitromethane, nitroethane, N-methyl pyrrole, 1,4-dioxane, butylene oxide, 1,3-dioxolane, toluene, diisopropylamine, methyl ethyl ketone, isobutyl alcohol and 2-butanol. Another reported property of at least one stabilized CAHCs (technical grade 1,1,1-trichloroethane) is that they may contain potential mutagens or carcinogens such as vinylidene chloride, dichloroethane and 1,2-epoxybutene (WHO, 1992, pp.17-18).

Some CAHCs such as pentachloroethane are not produced in bulk quantities for commercial purposes, but are formed for minor applications and research purposes, and also may still be formed as an intermediate or by-product impurity in commercial CAHC production processes (e.g. pentachloroethane has been found as an intermediate product in the conversion of trichloroethylene to tetrachloroethylene (WHO, 1986, p.100)).

Another source of information about chemical production and use in the US economy is the USEPA's Toxic Release Inventory (TRI), which as of reporting year 1996, contained information about the management and environmental release of 643 chemicals which are manufactured, processed or otherwise used in the US economy. The TRI data reporting threshold is facilities with ten or more employees, and which either manufacture or process at least 25,000 pounds (11.3 metric tons) per year, or otherwise use at least 10,000 pounds (4.5 metric tons) per year.

The series of four Exhibits (A-1, A-2, A-3, A-4) in **Attachment A** to this document present the TRI waste management and environmental release data for 66 CAHCs which reportedly may have been either manufactured, processed or otherwise used in the US economy as of 1996. As displayed in Exhibit A-1, for purpose of presentation, the 66 CAHCs identified in the TRI database, may be classified into three subclasses according to chemical composition:

- **CAHC subclass #1**: Chlorinated only (n = 32 chemicals).
- **CAHC subclass #2**: Chlorinated plus other halogens (n = 21 chemicals).
- **CAHC subclass #3**: Chlorinated plus other chemical elements or functional groups (n = 13 chemicals).

Although the RCRA listing pertains only to CAHC manufacturing operations (not to CAHC industrial processing or industrial use operations), and has been narrowed in scope to only a very small subset of CAHCs, as explained in the Risk Analysis Background Document to this listing, the TRI data are presented in this document to provide a broader economic context for portraying CAHCs.

[14] A chemical "isomer" is the unique structural form that a particular chemical compound may form during its production, when more than one structural form is chemically possible; isomers contain the same number and type of chemical atoms but differ in chemical bonding structure and chemical properties. For example, the chlorination of vinyl chloride or vinylidene chloride produces trichloroethane; but because trichloroethane ($C_2H_3Cl_3$) has two carbon atoms to which its three chlorine atoms may bond, it has two structural isomers: 1,1,1-trichloroethane which is the principle commercial reaction product, and 1,1,2-trichloroethane which may appear as an impurity in the manufacture of 1,1,1-trichloroethane (WHO, 1992, p.16).

EXHIBIT 7

Summary of Chlorinated Aliphatic Hydrocarbon Chemicals (CAHCs)
Manufactured in the United States (1994, USITC)

Item	USITC HTS No.	Name of chlorinated aliphatic chemical	1994 comp- anies	US Production (million pounds) 1994	1994 avg.price ($/lb)
A. Chlorinated only (n = 18 +):					
1	29031100	Chloromethane (methyl chloride)	6	998.4	$0.25
2	29031100	Chloroethane (ethyl chloride)	2	NR	NR
3	29031200	Dichloromethane (methylene chloride)	3	403.0	$0.17
4	29031300	Trichloromethane (chloroform)	3	479.1 +	$0.19
5	29031400	Tetrachloromethane (carbon tetrachloride)	3	NR	NR
6	29031500	*1,2-dichloroethane (ethylene dichloride)	10	16,744	$0.10
7	29031910	**Tetrachloroethane (perchloroethylene)	3	246.7	NR
8	29031950	1,1,1-trichloroethane (methyl chloroform)	3	NR	$0.31
9	29031950	1,1,2-Trichloroethane (vinyl trichloride)	1	NR	NR
10	29031950	Trichloronitromethane (chloropicrin)	3	6.9 +	$0.96
11	29031950	1-chlorobutane (n-butyl chloride)	1	NR	NR
12	29032100	Chloroethylene (vinyl chloride)	11	13,836	$0.21
13	29032200	Trichloroethylene	2	NR	NR
14	29032900	3-chloropropene	2	NR	NR
15	29032900	1,3-dichloropropene	1	NR	NR
16	29032900	2,3-dichloropropene	1	NR	NR
17	29032900	1,2,3-trichloropropane	1	NR	NR
18	29032900	1,1-dichloroethylene (vinylidene chloride)	2	161.7 +	$0.43
		Subtotal A =		32,876 +	
B. Chlorinated and with other halogens (e.g. bromine and/or fluorine, n = 10 +):					
19	29034000	Bromochloromethane	1	NR	NR
20	29034000	2-bromo-2-chloro-1,1,1-trifluoroethane	1	NR	NR
21	29034000	1-chloro-1,1-difluoroethane	2	NR	NR
22	29034000	Chlorodifluoromethane	4	304.4	$1.07
23	29034000	Chlorotrifluoroethylene	1	NR	NR
24	29034000	Chlorotrifluoromethane	2	NR	NR
25	29034000	Dichlorodifluoromethane	4	126.7	$2.05
26	29034000	1,1-dichloro-1-fluoroethane	2	NR	NR
27	29034000	Trichlorofluoromethane	4	16.1 +	$1.45
28	2903400	Trichlorotrifluoroethane	3	271.6	$1.65
29	290319	Other chlorinated aliphatics not above	NR	910.7	$NR
		Subtotal B =		1,629 +	
		Total A + B =		**34,505 +**	
C. Total halogenated hydrocarbon derivatives:					
	2903	Total halogenated hydrocarbon derivatives***	NR	36,174	$0.24
				Price range =	$0.10-$2.05

Explanatory Notes:

(a) Production data include the total output of US plants (i.e. the quantities produced for consumption within the producing plant, as well as the quantities produced for domestic sale and export).

(b) 1994 US production data source: US International Trade Commission, Synthetic Organic Chemicals:1994, (Nov.1995). Pounds production computed by OSW-EMRAD from USITC kilogram data by multiplying with ratio 2.203 lbs/kgm.

(c) NR = Data for chemical not reported by the USITC to protect confidential data for < 3 US producers.

(d) * Over 90% of 1,2-dichloroethane is used as an intermediate for the production of vinyl chloride and polyvinyl chloride.

(e) ** The symmetrical isomer 1,1,2,2-tetrachloroethane has commercial uses, whereas the unsymmetrical isomer 1,1,1,2-tetrachloroethane is not available in commercial quantities; it is present as an unisolated intermediate (impurity) in some processes for the manufacture of trichloroethylene and tetrachloroethylene from 1,2-dichloroethane (WHO, 1986, p.88).

(f) *** Total halogenated hydrocarbons include aliphatics greater than five carbons, plus cyclic and aromatic hydrocarbons (includes chlorinated plus brominated, fluorinated and iodinated compounds).

(g) Number of companies indicated above are overlapping; number of chemical plants may exceed number of companies.

(h) The chemical names and production quantities of all CAHCs are not listed above because data on minor quantities, captive intermediates (hexachlorocyclopentadiene, chloroprene, and dichlorobutane, USEPA 1984, p.8)), and by-product impurities are not reported by the USITC (e.g. pentachloroethane).

(i) List of chemicals above does not include polymers/copolymers manufactured from CAHCs as intermediate building blocks.

III.F. Are CAHCs Naturally-Occurring or Only Man-made?

As late as the 1980s, the scientific community asserted that CAHCs have only infrequent, known natural occurrences. Three of the then reported exceptions are the following CAHCs (WHO, 1979, pp.375, 405, 550, & WHO 1986, p.166):

- Carbon tetrachloride (tetrachloromethane) which may be formed in the troposphere by solar-induced photochemical reactions of manmade chlorinated alkenes which have been released into the air;
- Chloroform which may be formed naturally in the troposphere by solar-induced photochemical reactions of trichloroethylene, which itself is not known to be a naturally-occurring substance; and
- Chloromethane (methyl chloride) which is produced by in the oceans by seaweeds and a variety of marine microorganisms, and by combustion of organic matter such as forest fires.

However, by the 1990s, the scientific community published new assertions that about 2,000 chlorinated and other halogenated chemicals are discharged into the physical environment by plants, marine organisms, insects, bacteria, fungi, mammals, and by other natural processes (Gribble, 1994). The first international conference on naturally occurring organohalogens was held in 1993 in the Netherlands. It is now reported that chloride ions are normally present in plants, wood, soil and minerals, and their combustion (e.g. brush fires, vegetation fires, forest fires, volcanoes) inevitably leads to the formation of chlorinated organic compounds. Marine and terrestrial organisms are now also known to have biogenic mechanisms involving enzymes which may chlorinate (and halogenate) organic compounds in vivo (ibid, p.316A). At least **19 CAHCs** consisting of seven subclass#1 CAHCs (i.e. chlorinated only), and at least 12 subclass#2 CAHCs (i.e. chlorinated with other halogens), are now identified as naturally-occurring (ibid, p.315A). **Global natural production** by marine and terrestrial organisms, of the simplest CAHC, chloromethane, is estimated at five million tons (**10 billion pounds**) annually (ibid, p.310A).

III.G. What are the Names/Locations of Current CAHC Manufacturers in the US?

As noted in the introduction to this study, publicly-available rather than confidential business information (CBI) was preferred as information and data sources for preparing the background documents for the listing, to facilitate transparency for public review and comment. However, some information was designated by CAHC producing companies as CBI when collected in the Section 3007 survey administered by USEPA-OSW in 1991 and 1996.

Consequently, the background data and information available to the USEPA-OSW during development of this listing proposal also consisted of CBI information. In order to minimize reliance on CBI data, and to exhaust available public information sources, OSW-EMRAD consulted other publicly available databases, in addition to the RCRA Section 3007 survey. Three such databases consulted are the (a) US International Trade Commission's (USITC) "Synthetic Organic Chemicals" production and sales database, (b) the USEPA's "Toxic Release Inventory" (TRI) database, and (c) the USEPA's "Biennial Reporting System" (BRS) database.

Based on the most recent annual survey available (1994 data year), the 29 companies displayed below in Exhibit 8 are listed by the USITC as manufacturers of CAHCs in the United States (USITC, 1995). As will be displayed later in this study from another database source, the total number of CAHC manufacturing facilities, establishments, and geographic sites are actually greater than 29, because many CAHC-producing companies own and operate more than one CAHC facility (i.e. the number of facilities is greater than the number of companies):

EXHIBIT 8

List #1 of 3: 29 CAHC Manufacturing Facilities in the US
As Identified by the **US International Trade Commission** (1994 data year)

	Name of CAHC Manufacturing Company	Company Office Address (may not coincide w/CAHC plant)
1	Albright & Wilson, Americas, Inc.	Charleston SC
2	Allied Signal Inc. (Engineered Materials Sector)	Morristown NJ
3	Ausimont USA Inc.	Morristown NJ
4	BF Goodrich Company	Cleveland OH
5	Borden Chemical & Plastics Delaware Limited Partnership	Geismar LA
6	Dover Chemical Corp. (subsidiary of ICC Industries, Inc.)	Dover OH
7	Dow Chemical Company	Midland MI
8	Dow Corning Company	Midland MI
9	E.I. DuPont de Nemours & Co. Inc. (Chemicals & Pigments)	Wilmington DE
10	Elf Atochem North America Inc.	Philadelphia PA
11	Ferro Corp. (Keil Chemical Division)	Hammond IN
12	Formosa Plastics Corp. (Louisiana)	Baton Rouge LA
13	General Electric Company (Silicone Products Division)	Waterford NY
14	Geon Co.	Avon Lake OH
15	Georgia Gulf Corp. (Plaquemine Division)	Atlanta GA
16	Great Lakes Chemical Corp.	Lafayette IN
17	Holtrachem Mfg LLC	Orrington ME
18	LaRoche Industry Inc.	Baton Rouge LA
19	Niklor Chemical Co. Inc.	Long Beach CA
20	Occidental Chemical Corp. (Chemical Group)	Dallas TX
21	Occidental Chemical Corp. (Oxy Petrochemicals Inc.)	Dallas TX
22	Occidental Chemical Corp. (Polymers & Plastics Group)	Dallas TX
23	OxyMar	Ingleside TX
24	PPG Industries, Inc.	Pittsburgh PA
25	Shell Oil Company (Shell Chemical Company)	Houston TX
26	Vista Chemical Company	Houston TX
27	Vulcan Materials Company (Chemicals Division)	Birmingham AL
28	Westlake Corp.	Houston TX
29	Witco Corp.	Woodcliff Lake NJ

The exact number and geographic location of CAHC-manufacturing facilities is not publicly discernable from the USITC database. OSW-EMRAD identified the **26 facilities** displayed in Exhibit 9 below as CAHC manufacturers in the USA, based on information provided by chemical manufacturing companies to the USEPA in the 1995 Biennial Reporting System (BRS). OSW-EMRAD identified these facilities from the BRS database by searching for facilities which generated the F-list and K-list RCRA hazardous waste codes (listed elsewhere in this document), which are related to the production of CAHCs.

EXHIBIT 9

List #2 of 3: 26 CAHC Manufacturing Facilities in the US
As Identified in the USEPA **BRS Database** (1995 data year)

	Company Operating Facility	Facility Location		EPA ID Number
1	BASF Corp	Wyandotte	MI	MID064197742
2	Bayer Corp	Houston	TX	TXD084972777
3	BF Goodrich	Calvert City	KY	KYD006370167
4	Borden Chemical & Plastics	Geismar	LA	LAD003913449
5	Dow Chemical	Freeport	TX	TXD008092793
6	Dow Chemical	Plaquemine	LA	LAD008187080
7	E.I. DuPont	Orange	TX	TXD008079642
8	E.I. DuPont	Victoria (#1)	TX	TXR000001016
9	E.I. DuPont	Victoria (#2)	TX	TXD008123317
10	Exxon Chemical	Houston	TX	TXD082684002
11	Formosa Plastics	Baton Rouge	LA	LAD041224932
12	Formosa Plastics	Point Comfort	TX	TXT490011293
13	Geon Company	Avon Lake	OH	OHD987053949
14	Geon Company	LaPorte	TX	TXD070133319
15	Georgia Gulf Corp	Plaquemine	LA	LAD057117434
16	Gibraltar Chem Resources	Tyler	TX	TXD000742304

17	Occidental Chemical	Belle	WV	WVD005010277
18	Occidental Chemical	Convent	LA	LAD098168206
19	Occidental Chemical	Deer Park	TX	TXD981911209
20	Occidental Chemical	Gregory	TX	TXD982286932
21	PPG Industries	Westlake	LA	LAD008086506
22	Shell Chemical	Norco	LA	LAD980622104
23	Vista Chemical	Westlake	LA	LAD086478047
24	Vulcan Chemicals	Geismar	LA	LAD092681824
25	Vulcan Chemicals	Wichita	KS	KSD007482029
26	Westlake Monomers	Calvert City	KY	KYD985072008

Because of the fact that the above company/facility list was compiled by USEPA-OSW-EMRAD using 1995 BRS reporting year data (which were the most recent available at the time of the study), this list may not be accurate relative to the current year (1999). One conclusion from this comparison of findings from public access databases is that the exact number of CAHC producing facilities currently operating in the United States is not readily discernable.

During the course of developing this listing proposal, USEPA-OSW-HWID developed a working list of current CAHC manufacturers, in consultation with industry contacts. This working list initially (circa 1992) contained 28 facilities with 20 associated parent companies, but OSW refined this list by subtraction of two plants which closed their CAHC manufacturing processes, two which produce "de minimis" CAHC quantities annually, and one which was double-counted. Consequently, OSW's current working list consists of **23 US CAHC manufacturing facilities** operated by **16 parent companies**, as displayed in Exhibit 10 below. The map provided as Exhibit 11 displays the location of 26 of the 28 initially-identified facilities, 17 of which are clustered along the Gulf of Mexico coastal area of Texas and Louisiana. This economic study applies this ***master list*** for estimating potential industry compliance costs associated with the listing proposal.

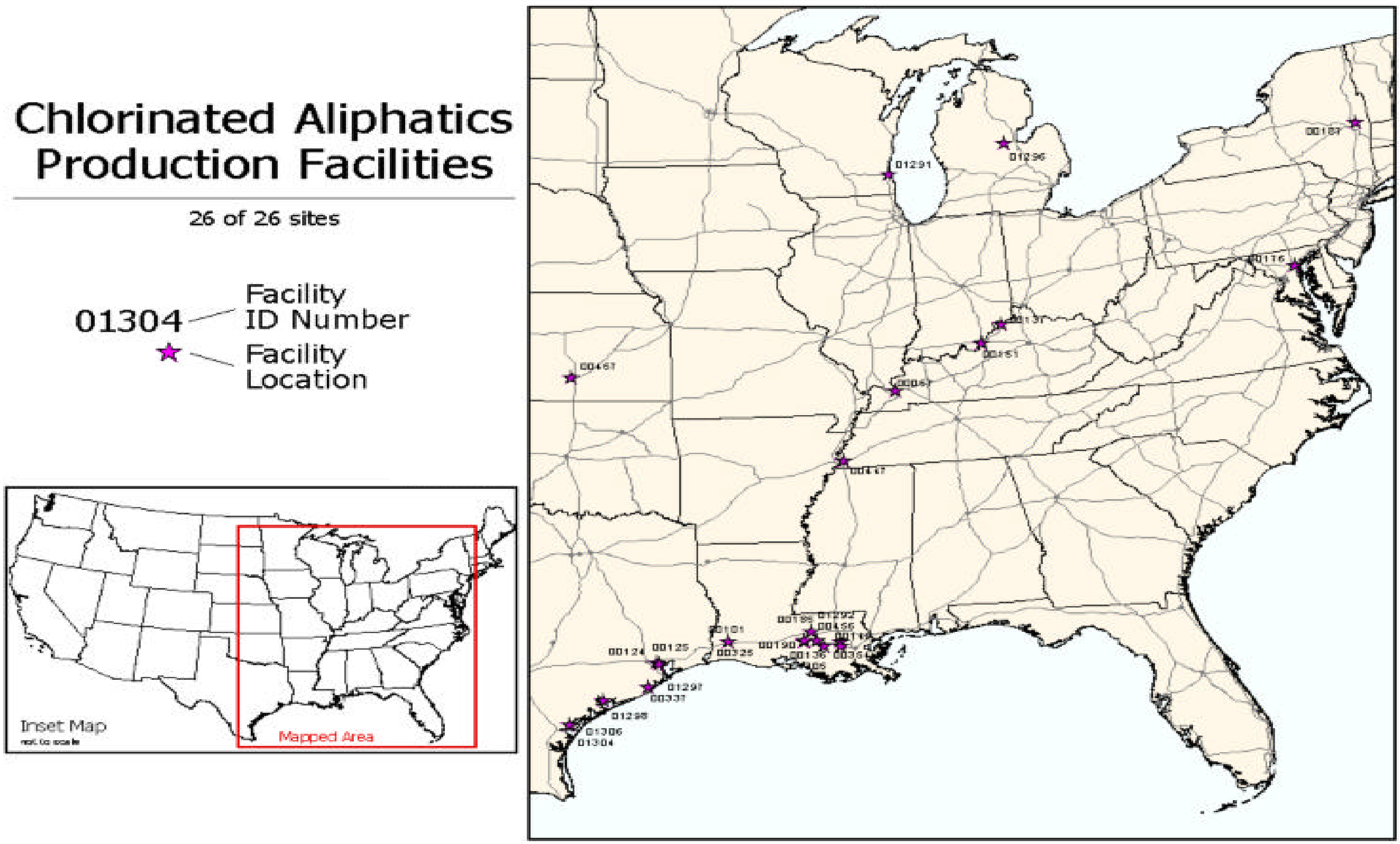
EXHIBIT 10

List #3 of 3: USEPA-OSW Master Reference List of 23 CAHC Manufacturing Facilities in the US for Risk Analysis and Estimation of Industry Compliance Cost for this Listing Proposal (Source: USEPA-OSW-HWID **Section 3007 survey**).

Facility Count	Company Count	Company Name*	CAHC Manufacturing Facility Location City	State	Type of CAHC Process/ Product**
1	1	Borden Chemicals	Geismar	LA	VCM
2	2	Condea Vista	Westlake	LA	EDC/VCM
3	3	Dow Chemical	Freeport	TX	Mixed CAHCs
4		Dow Chemical	Plaquemine	LA	EDC/VCM
5	4	Dow Corning	Carrollton	KY	Methyl Chloride
6		Dow Corning	Midland	MI	Methyl Chloride
7	5	DuPont-Dow	LaPlace	LA	Chloroprene
8		DuPont-Dow	Louisville	KY	CBI
9	6	Formosa	Baton Rouge	LA	EDC/VCM
10		Formosa	Point Comfort	TX	EDC/VCM
11	7	FMC	Baltimore	MD	Methallyl Chloride
12	8	General Electric	Waterford	NY	Methyl Chloride
13	9	Geon	LaPorte	TX	EDC/VCM
14	10	Georgia Gulf	Plaquemine	LA	EDC/VCM
15	11	Occidental	Convent	LA	EDC
16		Occidental	Deer Park	TX	EDC/VCM
17		Occidental (OxyMar)	Ingleside (Gregory)	TX	EDC/VCM
18	12	PPG Industries	Lake Charles	LA	Mixed CAHCs
19	13	Shell Chemical	Norco	LA	Allyl chloride
20	14	Velsicol Chem. Corp	Memphis	TN	Hex
21	15	Vulcan Chemicals	Geismar	LA	Mixed CAHCs
22		Vulcan Chemicals	Wichita	KS	Mixed CAHCs
23	16	Westlake Monomers	Calvert City	KY	EDC/VCM

Explanatory Notes:
(a) * Company name shown may represent subsidiary (affiliate), not parent company name.
(b) ** Key to types of CAHCs (chlorinated aliphatic hydrocarbon compounds) listed above:
EDC = ethylene chloride; Hex = Hexachlorocyclopentadiene; VCM = vinyl chloride monomer.
(c) CBI = confidential business information claimed by company in USEPA RCRA Section 3007 survey.

EXHIBIT 11


Chlorinated Aliphatics
Production Facilities
26 of 26 sites
01304
Facility
ID Number
Facility
Location
Inset Map
Mapped Area

III.H. Is the US CAHC Manufacturing Industry Static or Dynamic?

In addition to changing CAHC-manufacturing plant locations, this industry sector exhibits dynamic business activity involving changing company ownership and plant production capacities, as exemplified by the recent announcement of a planned **joint venture** between **Vulcan Chemicals** and **Mitsui & Company**, to expand ethylene dichloride (EDC) production at Vulcan's Geismar LA plant by early 2000. The $200 million project is designed to expand EDC annual capacity at the plant from 300 million to 540 million pounds, using an oxygen-based EDC technology which will reduce air emissions, and rather than being consumed internally for polyvinyl chloride (PVC) production, Mitsui plans to buy all the EDC output for export to Asian PVC plants (C&EN, 29 June 1998, p.17).

The CAHC production capacities for most of the US CAHC manufacturing facilities are available at the ChemExpo (Schnell Publishing Company) Internet website http://www.chemexpo.com/news/ . Since OSW-HWID's generation of the above master list for purpose of designing the risk analysis for the present RCRA listing proposal, there have been at least five changes in the **market structure** (i.e. number of facilities and capacity) and **facility ownership** of the CAHC manufacturing industry, as identified by the ChemExpo website for vinyl chloride (VCM) production when OSW-EMRAD consulted it for research for this document (http://www.chemexpo.com/news/PROFILE980216.cfm , updated as of February 1998):

- **Borden Chemicals Company** plans after the end of 1999, to expand its 320 million pound (160,000 short tons) acetylene-based VCM plant by 250 million pounds.

- **Georgia Gulf Company** added 350 million pounds capacity at Plaquemine in late 1996.

- **OxyMar**, a joint venture of Occidental and Marubeni Companies, completed a 700-million pound expansion of its Ingleside, Texas VCM facility in July 1997, increasing capacity to 2.1 billion pounds.

- **PHH Monomers**, the 50::50 joint venture between PPG Industries and Condea Vista, opened a 500 million pound facility at Lake Charles in late 1996.

- **Shintech Company** plans to construct a new $700 million vinyls complex, with 500,000 metric tons (1.102 billion pounds) each annual production capacity for VCM and PVC in St.James Parish, LA. This plan has reportedly been put on hold because of community resistance (USA Today, "LA Town Successful in Stopping Plastics Plant", Traci Watson, 18 Sep 1998, http://archives.usatoday.com).

Some manufacturers of CAHCs use them captively onsite (i.e. in ***vertically integrated*** industrial processes), to produce other chemical products. For example, the chemicals ethylene dichloride (**EDC**) and vinyl chloride monomer (**VCM**) are used by some companies captively for the production of polymers (i.e. plastics precursors for the manufacture of polyvinyl chloride). Based on the USITC 1992 and 1994 data, there have been 20 CAHC-based polymer manufacturing companies, of which at least seven companies on the master list above (Borden, Dow, Formosa, Geon, Georgia Gulf, Occidental, Westlake), are also CAHC manufacturers.

III.I. Have CAHCs Been Produced Historically in Other Locations in the United States?

In addition to current databases, there are assorted documents which contain historical information about the CAHC production industry in the United States. Historically, CAHCs have been manufactured and/or used as feedstocks/intermediates in chemical production plants in at least 15 states in the US. The historical data on the number and location of CAHC production facilities serves to illustrate the dynamic business activity in this industry sector. As late as 1975, CAHCs were produced in the United States by 32 companies in 58 plant locations, the identity of those which no longer apparently produce CAHCs are listed in Exhibit 12 below (source: Monsanto 1979, pp.42-47; NRC 1978, p.66):

EXHIBIT 12

32 US Plant Locations Where CAHCs Once (1975) But Are No Longer Produced

(Plant Annual Capacities in Metric Tons*)

Cold Creek AL	11,300	Baltimore MD	2,700	Bayport TX	417,300
LeMoyne AL	90,700	Midland MI	163,300	Cedar Bayou TX	59,000
Carson CA	45,400	Muskegon MI	4,500	Corpus Christi TX	136,100
Irwindale CA	1,800	Deepwater Pt NJ	111,100	Oyster Creek TX	499,000
Pittsburg CA	45,400	Lockport NY	3,600	Port Neches TX	81,600
Delaware City DE	90,700	Niagra Falls NY	68,000	Institute WV	72,600
Brandenburg KY	59,000	Syracuse NY	18,600	Moundsville WV	95,700
Carrollton KY	9,100	Waterford NY	22,700	Natrium WV	50,400
Sauget IL	64,900	Henderson NV	31,800	N.Martinsville WV	111,100
Mount Vernon IN	27,200	Ashtabula OH	22,700	S.Charleston WV	136,100
Taft LA	45,300	Barberton OH	2,300		

Total capacity in 1975 = 2,601,000 (5.735 billion lbs)

Explanatory Notes:
(a) * Capacities may refer to final chemical product for which CAHCs were used as reaction feedstocks or intermediates. Non-CAHC chemicals produced using CAHCs in the manufacturing process included phosgene and propylene oxide. Chlorinated benzene (aromatic ring) compounds were also produced in some of these plants, a class of CAHCs which are outside the scope of the present listing study.
(b) Metric ton = 1,000 kilograms = 2,205 pounds (i.e. multiply capacities by 2,205 for pound equivalents).
(c) Source: USEPA report written by the Monsanto Co., Aug 1979, Table 7, pp.44-47.

III.J. What Are the CAHC Manufacturing (Supply) Processes in the US?

CAHCs are manufactured by the chemical industry involving the further processing of five of the eight basic, **first-level derivative chemicals** in the organic chemical synthesis chain: butadiene, butylene, ethylene, methane, and propylene (CMA 1997, pp.9-17). The other three first-level organic chemical derivatives produced from oil, natural gas and coal raw materials -- benzene, toluene, xylene -- are cyclical compounds which are used for the manufacturing of chlorinated cyclic hydrocarbon compounds (among other chemicals), which are not included within the scope of this economic study.

In large part, CAHCs are manufactured by the ***chlorination*** of the first-level organic derivatives (i.e. aliphatic hydrocarbons refined from oil/gas), but may also be produced from second-level derivatives as direct products, co-products, and as by-products.[15] For example, carbon tetrachloride may be produced from at least three chemical chlorination processes through the methane or ethylene organic chemical chains: (a) chlorination of methane, (b) chlorination of carbon disulfide, and (c) chlorination of partially chlorinated short-chain hydrocarbons as a co-product with tetrachloroethylene (WHO, 1979, p.373). The production of CAHCs constitutes over 40 percent of total chlorine consumption by the US chemical industry (CMA, 1992, p.31).

Although the plants which manufacture CAHCs differ in process design, size and specific CAHC products manufactured, a common factor is the utilization of one or more general chemical reaction types in a series of ***unit processes*** to generate higher degrees of chlorinated compounds. Most of the CAHCs were first synthesized in the early 1800s, with commercial production in the US of 1,2-dichloroethane reported in 1922, and of carbon tetrachloride and chloroform reported as of

[15] CAHCs are unintended by-products from anthropogenic activities: (a) tetrachloroethane reportedly may be formed in small quantities as unwanted by-products during the sanitary chlorination of water in municipal sewage and water treatment plants, with concentrations in samples of water utilities ranging from 0.07-0.46 micrograms/liter (WHO, 1979, p.496), and (b) cigarette smoke contains chloromethane (WHO, 1986, p.168). These examples represent from a strict definition perspective, other sources besides chemical plants of CAHC production in the US, but are outside the scope of the RCRA listing proposal.

1925 (Sconce, p.15), but large volume growth of commercial production of many of the CAHCs did not begin in the US until the 1930s-50s.

More than one type (i.e. chemical composition) of CAHCs may be produced by a single chemical plant, while more than one chemical plant may produce CAHCs using different chemical reaction processes, in conjunction with different industrial product lines (as is illustrated by the array of multiple **Standard Industrial Classification (SIC) codes** associated with single chemical plant facilities displayed in **Attachment C**). Furthermore, chemical plants in one geographic region (or country) may produce CAHCs using processes different from other regions (or countries).

For example, the chlorination reaction between ethylene and chlorine yields a mixture of ethylene dichloride, 1,1-dichloroethane, and 1,1,2-trichloroethane. By controlling the temperature of the reaction and by using specific catalysts (e.g. ethyl bromide, metal chlorides), the production of specific CAHC products may be enhanced. Specific CAHCs may be produced by more than one method; for example, ethylene dichloride may also be produced by hydrochlorination of ethylene, and as a by-product of trichloroethylene syntheses (NIOSH, 1976, p.16). Basically, the following five general ***chemical conversion processes*** may be used to manufacture CAHCs from chlorine and hydrocarbon feedstocks (USEPA 1984, pp.8-15):

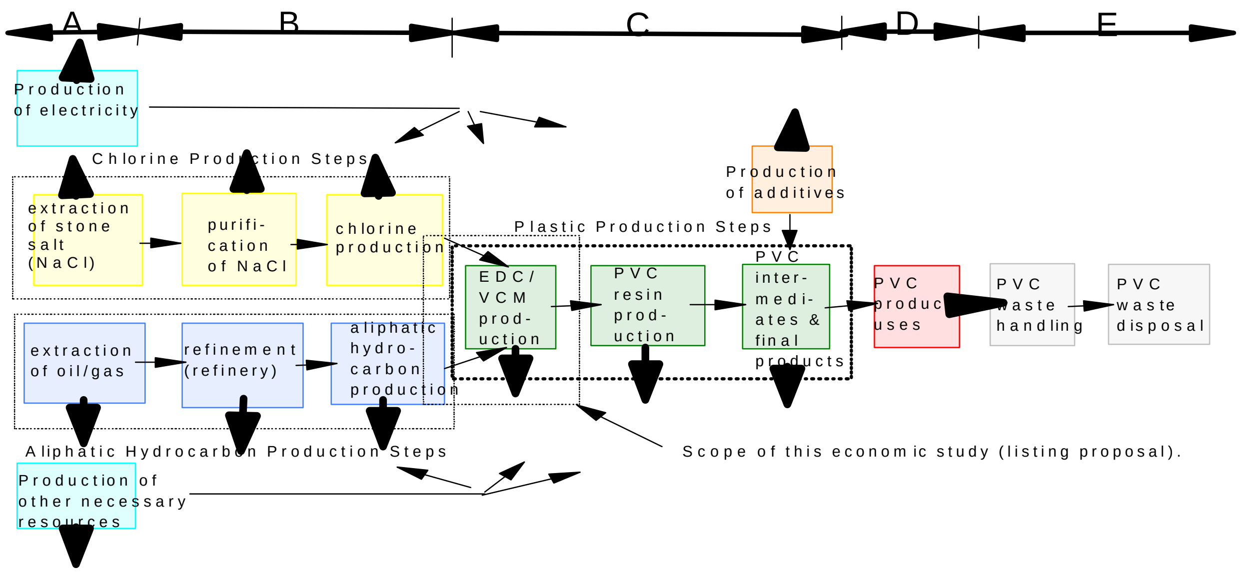
- Free radical initiation: Addition, substitution and pyrolysis reactions using molecular chlorine (gas) as a feedstock, at high reactor temperatures ranging from 200-900^{o}C, and reactor residence times of 3-12 seconds.
- Lewis acid catalyzed: Addition and substitution reactions using molecular chlorine (gas) as a feedstock, at low reactor temperatures (40-50^{o}C) and with metal-based catalysts (e.g. mercury chloride or zinc chloride).
- Oxychlorination: Utilizing hydrogen chloride, air and a metallic catalyst (e.g. copper) at medium temperatures (230-315^{o}C), with 15-22 reactor residence times.
- Base catalyzed: Dehydrochlorination at low temperatures with sodium hydroxide slurries.
- Metal catalyzed: Catalyzed (e.g. zinc chloride) chlorination of alcohols at high temperature (500^{o}C).

Each process consists of an integrated series of chemical reactors and associated purification units employed to produce a range of desired CAHC products. One process involves low temperature acid catalyzed reactor units which reportedly do not generate quantities of hazardous chemical constituents in its process wastes. Most reaction mechanisms involve high temperatures in a chemical process catalyzed by "free radicals"; the free radical conversions have been of interest to the USEPA because there is carry-over of toxic by-products as well as intrinsically toxic intermediates and products formed during the these processes (USEPA 1984, p.22). Either process may occur in conjunction with other catalyzed reactions in integrated process units.

Some CAHC production methods involve using inorganic (metal) compounds as reactants or catalysts, such as the production of choromethane (methyl chloride) with a reaction involving dimethyl sulphate with aluminum chloride or sodium chloride, or involving decomposing monochlorodimethyl ether with zinc (WHO, 1986, p.163). CAHCs may also serve either as captive-process or as open-process intermediate feedstocks for the production of other chemicals.

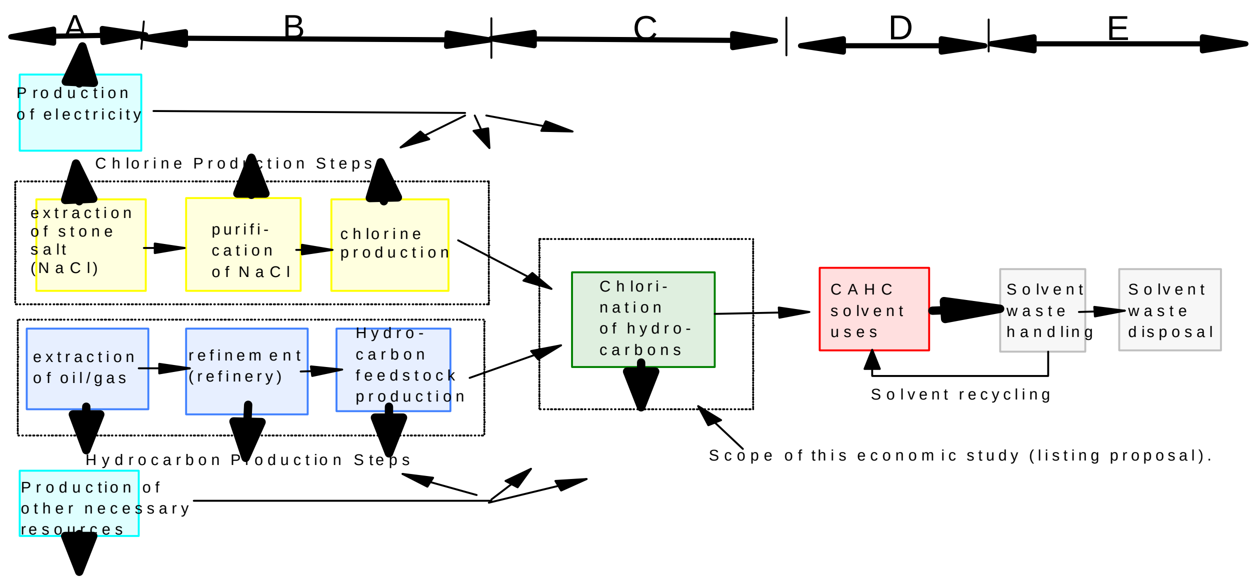
The next two exhibits (Exhibits 13 and 14) below present box-flow diagrams which depict the industrial processes associated with the production of CAHCs, including upstream and downstream processes and economic activities, from an ***industrial ecological perspective*** (i.e. within a "life cycle assessment", "substance flow analysis", "materials flow analysis", or "cradle-to-grave" framework). The arrowed sections designated as A, B, C, D, E on each exhibit represent the five basic life cycle stages (i.e. A = extraction, B = processing, C = manufacture, D = use, E = disposal).

EXHIBIT 13
Industrial Ecology Life Cycle Depiction of CAHC-Based **Plastics Manufacturing**



Large arrows indicate by-product and waste generation/treatment/disposal in upstream processes.
Source: Adapted from Tukker et al, 1997, p.96, & Peerebom et al., 1998, p.112.

EXHIBIT 14
Industrial Ecology Life Cycle Depiction of CAHC **Solvent Manufacturing**



Large arrows indicate by-product and waste generation/treatment/disposal in upstream processes.
Source: Adapted from Peerebom et al., 1998, p.112, and Ayres & Ayres, 1997, p.83.,

III.K. How Effective Are CAHC Manufacturing Processes in Producing Desired Chemical Products?

The free radical catalytic processes are not totally specific in producing a single desired chemical product; thus reactor conditions can only be arranged to maximize the quantity of desired products. Therefore, for any given CAHC manufacturing facility, a **range of CAHC products** will be formed with different molecular structures (i.e. number of chlorine and carbon atoms), and these different products have been found in plant process wastes. In addition, other chlorinated aromatic products (i.e. ring-like molecular structures) have been found as contaminants in waste samples from these types of chemical manufacturing facilities (Fed.Reg. 10 Feb 1984, p.5309; USEPA 1984, p.23).

The technical "Background Document" to the 1984 USEPA listing proposal for chlorinated aliphatics (i.e. which created the RCRA F024 and F025 waste codes), provides the following description of chemical formation during the ***free radical manufacture*** of chlorinated aliphatics, based on chemical reaction theory and knowledge of actual industrial processes:

> "[F]or any given C_1-C_5 process, a range of by-products will be formed having both higher and lower carbon atoms and higher and lower amounts of chlorine substitution... For example, the thermal free radical chlorination of ethylene will yield primarily the initial desired [i.e. two-carbon based molecule] products, ethyl chloride and dichloromethane. However, polychlorinated C2 compounds and longer carbon chain length chlorinated compounds and tars are also produced. The primary side reactions which are predicted to produce the majority of waste constituents are free radical initiated polymerizations, polychlorinations, and dechlorinations, carbon bond cleavages, and cyclizations... Therefore, free radical size reactions (as well as other types of side reactions) will theoretically lead to many different chemical species having greater and lesser carbon chain lengths, different skeletal [i.e. molecular] structures, degree of bond saturation, and degree and position of chlorination... For example, a two-carbon chain feedstock (e.g. ethylene) side product will include one carbon chlorinated species (chloromethane, dichloromethane) as well as chlorinated coupling products (chlorinated butanes, polychlorinated polymers, and tars). An almost infinite number of waste constituents can be predicted from organic chemical mechanistic considerations."
> (Sources: USEPA, 1984, pp.22-26; references for theoretical predictions cited in 1984 are Kirk Othmer, Encyclopedia of Chemical Technology; Van Oss, Chemical Technology: An Encyclopedic Treatment, Morrison & Boyd, Organic Chemistry (textbook); and Fieser & Fieser, Advanced Organic Chemistry (textbook)).

Because of the fact that **undesired side- or by-product constituents** have been found in the purification wastes from these processes, carry-over or retention of what in most cases is a toxic product -- as described in the following section below -- into these wastes typically occurs.

For both the 1984 listing proposal and the present (1999) listing proposal for the CAHC manufacturing industry, the USEPA compared the predicted range of toxic constituent by-products, with actual chemical analyses of wastes from these processes. The 1984 USEPA technical "Background Document" (pp. 2-3 & Table 5, pp.49-52) listed a total of **36 hazardous constituents** of concern, and the more recent risk analysis report (RTI, 1998, p. 4-9) which supports the current listing proposal, listed a total of **61 constituents of concern**, based on chemical sampling analysis during 1997 of actual waste streams from CAHC manufacturing plants in the US. These constituents of concern include chlorinated and non-chlorinated volatile organics, metals, and aromatic and molecularly complex (e.g. dioxin and dibenzofuran) compounds, as described in the "Risk Analysis Background Document" for this listing proposal (as cited in the Federal Register announcement for the proposal, and as available from the RCRA Docket by calling 800-424-9346, or by Internet request via the website http://www.epa.gov/epaoswer/osw/infoserv.htm#info).

IV. CAHC MANUFACTURING WASTE MANAGEMENT BASELINE PRACTICES

IV.A. What is the Source of USEPA's Information on Baseline Waste Management in this Industry?

This document presents complementary and overlapping information collected from two sources of baseline waste management practices, one which is a publicly-available, annually updated database on industrial chemicals, and a second which was custom-designed for this particular RCRA listing proposal.

Presentation of both data sources in this document is consistent with the stated methodological orientation of this study, in at least two ways: (a) maximizing the transparency and public review of the data and information which underlie the analysis in this document, and (b) providing an industrial ecological framework to consideration of industrial wastes, and to wastes generated in association with the production and use of CAHCs in the economy, in particular:

- **1996 TRI Database**: USEPA's 1996 Toxic Release Inventory (TRI) database which contains waste management and environmental release[16] information on 643 chemicals manufactured, processed and used in the US economy. One of the specific purposes for the TRI database is to provide the public with a means to identify facilities and chemical release patterns that may warrant further study and analysis, including using the TRI as a tool for risk identification. The TRI is a relatively broad database compared to the narrow scope of this listing proposal. The 1996 TRI data are available in the May 1998 USEPA report nr. EPA-745-R-98-005 via the Internet at http://www.epa.gov/opptintr/tri/pubdat96.htm .

- **1997 Industry Survey**: USEPA-OSW's 1991/1997 RCRA Section 3007 industry survey targeted by at CAHC manufacturing facilities potentially affected by this 1999 RCRA listing proposal. The survey instrument was a **46-page questionnaire** mailed directly to facilities identified by OSW (a blank copy of the questionnaire is contained in the "Listing Background Document"). Compared to the TRI database, this custom-designed survey provides a narrow scope focus on the particular subset of industrial facilities, industrial operations, and types of CAHCs relevant to the listing proposal.

The descriptive information collected from each of these two data sources concerning current (baseline) waste management practices associated with the manufacture of CAHCs, is summarized below.

IV.B. What Are the CAHC-Related Industrial Waste Management Practices Reported in the TRI?

Exhibit A-2 of **Attachment A** to this document presents baseline waste management data for chemical manufacturing, processing and otherwise using, industrial facilities reporting to the 1996 TRI. The data are expressed in tons of CAHCs in wastestreams managed, and are displayed for 66 different CAHCs grouped according to three CAHC subclasses (i.e. chlorinated only, chlorinated plus

[16] In contrast to other information sources, the vocabulary used in the USEPA's Toxic Release Inventory (TRI) database may be unique in the following way. The TRI defines the phrase "environmental releases" to include discharges (intentional or unintentional) of a chemical to the air, water, land, or underground environment. TRI-defined "releases" apply to wastes which are otherwise defined as "managed" or "disposed" in other information references. For example, some databases may classify wastes as being "managed" or "disposed" if handled in landfills, landfarming, surface impoundments, wastepiles, or discharged in directly to underground wells or to surface waters. However, the TRI classifies such handling as waste "releases", not waste "management". The TRI defined waste "management" as constituting recycling, and the destruction or alteration of the chemicals in wastes via energy recovery (excluding incineration), and treatment. For more information about the TRI, call the USEPA EPCRA Hotline at 800-424-9346 or via the Internet website http://www.epa.gov/enviro/html/tris/tris_overview.html.

other halogens, and chlorinated plus other chemical elements). Baseline waste management practices are also grouped according to onsite and offsite management, as summarized in Exhibit 15 below.

Manufacturing facilities reported a total of **819,013 tons** (1.64 billion pounds) of CAHCs in industrial wastes generated in 1996. The total amount of waste generated is larger than the quantities shown below, because wastestreams may contain more than one type of chemical or other constituent. However, this quantity is not directly relevant to the RCRA listing proposal because the proposal is targeted not at CAHCs in wastes, but at the small subset of industrial facilities which manufacture CAHCs. Also, the scope of the "Risk Analysis Background Document" for this listing proposal is not limited to only CAHCs in wastes, but also to the potential risks associated with other chemical constituents in wastes generated by CAHC manufacturing facilities.

EXHIBIT 15

Summary of 1996 TRI on Baseline Waste Management Practices
For Handling CAHC-Containing Industrial Wastes
in US Manufacturing Facilities in SIC codes 20-39

	Waste Management Methods (tons CAHCs in waste)				
	Captive Waste Management*			Non-Captive	Total***
CAHC Subclass	Onsite	Offsite	(On + Off)	Releases**	Generated
1.Chlorinated only	561,858	52,805	614,663	57,233	671,570
Row percentages	84%	8%	92%	8%	100%
2.Chlorntd + other halogens	116,227	2,453	118,680	15,953	134,504
3.Chlorntd + other elements	12,604	313	12,917	23	12,939
Total =	690,688	55,572	746,260	73,208	819,013
Column percents	84%	7%	91%	9%	100%

Explanatory Notes:
(a) * Captive management represents the quantity of CAHCs in wastes destroyed or chemically altered in industrial waste management operations such as treatment, recycling, combustion or energy recovery. Quantities altered may be less than quantities which enter a treatment operations (the remainder being environmental releases).
(b) ** Non-captive releases are the quantity of CAHCs which ultimately are deposited or "disposed" unaltered into the environment in waste management operations involving landfills, landfarming, surface impoundments, surface water discharges, underground injection, and fugitive point or non-point emissions (refer to Exhibit A-3 in Attachment A to this document for detailed release data for industrial wastes containing CAHCs).
(c) *** Total may not equal row items due to rounding error, or other unique considerations in the TRI database.

As displayed in Exhibit A-2 of Attachment A to this document, the **top five CAHCs occurring in wastes** generated in 1996 by US manufacturing facilities are, as measured by total quantities managed plus released per chemical constituent in waste, are the following:

1. Dichloromethane
2. Vinyl chloride (vinyl chloride monomer or "VCM")
3. 1,2-Dichloroethane (ethylene dichloride or "EDC")
4. Trichloroethylene
5. Tetrachloroethylene

These top-five CAHCs comprise 52% of the total chemical mass of 66 different CAHCs reported in US industrial manufacturing wastes in 1996, as reported in USEPA's TRI database.

IV.C. How are the Section 3007 Survey Data (Non-CBI & CBI) Summarized in this Document?

Under authority of RCRA Section 3007, in 1992 and again in 1997, the USEPA-OSW administered a written survey questionnaire to US chlorinated aliphatic chemical manufacturing facilities. The primary purpose of the survey was to collect descriptive information and data concerning the generation and management of wastes associated with these types of industrial processes.

Companies were provided the opportunity to designate their answers to the survey as

confidential business information (CBI). Consequently, the USEPA may not reveal all data collected in this survey. However, this section presents a summary of select sections of the survey data collected relevant to this economic assessment, with CBI data masked by aggregation of individual data, and by display of only non-CBI individual data. To protect facility survey data confidentiality, OSW-EMRAD aggregated survey data in spreadsheets attached to this document according to the following five summary statistics, as a good faith attempt to not reveal CBI data for individual facilities:

• **Survey medians**: represent the middle value across all data-reporting survey facilities, i.e. 50% of facilities are below and 50% of facilities are above the median value. Medians displayed only if four or more data observations collected in the survey for a particular datafield. OSW-EMRAD applied this cutoff rule because the median value of three datapoints is equal to the middle value, which serves indirectly to reveal the actual datum for one facility. For "skew-shaped" (i.e. asymmetrical) data distributions – i.e. when values across facilities are clustered at one end of a range of values, rather than being "normally-shaped" (i.e. symmetrical) clustered around the middle of a range -- medians are better indicators of "average" characteristics than the simple mean.

• **Survey means**: represent either a simple or weighted average across all data-reporting survey facilities. Most means are simple means, but some are weighted means according to facility annual wastestream quantities. Means displayed only if three or more data observations collected in the survey for a particular datafield. OSW-EMRAD applied this cutoff rule because for one survey datafield, two respondents reported identical values; therefore the standard deviation to the mean is zero, which serves indirectly to reveal the actual data for both facilities in this case.

• **Survey standard deviations**: represent either the population ("n method") or sample ("n-1 method") standard deviation across all data-reporting survey facilities, depending upon whether all facilities relevant to the datafield supplied meaningful and complete data, or only if a portion of all relevant facilities supplied complete data, respectively. Standard deviations displayed only if three or more data observations collected in the survey. The standard deviation is a statistical indicator of the variability between facilities about the mean value for a particular datafield; larger standard deviations indicate greater variability (i.e. a broad range in values across all facilities) than smaller standard deviations, relative to the magnitude of the mean. Furthermore, standard deviations may serve as indicators of the lower and upper possible values across all facilities for a particular datafield. In cases where the mean and median are approximately equal -- which indicates a "normal-shaped" data distribution -- 68% of all facility values may be expected to lie within the interval +/- 1.0 standard deviation about the mean, and 95% of all facility values may be expected to lie within +/- 2.0 standard deviations about the mean. This is called the "Empirical Rule" of statistical science. However, in cases whether the mean and median are not approximately equal – which indicates a "skewed" distribution, "Chebyshev's Theorem" of statistical science may be applied: 75% of all facility values may be expected to lie within the interval +/-1.0 standard deviation about the mean, and 89% of all facility values may be expected to lie within +/-2.0 standard deviations about the mean.[17]

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[17] Additional information about the "Empirical Rule" and "Chebyshev's Theorem" is available from introductory textbooks on statistics such as McClave, James T. and P.George Benson, Statistics for Business and Economics, 4th edition, Dellen & Collier-MacMillan Publishers, 1988, pp.104-109.

• **Survey totals**: represents the summation over data provided by all survey facilities relevant to a particular information item. In some cases, all data including CBI data are included in the totals shown only if three or more CBI data are included so that single CBI responses are masked; otherwise, only non-CBI subtotals are presented.

• **Number of survey observations**: represents the number of survey facilities which reported meaningful and complete data for a particular datafield. The total possible number in the RCRA Section 3007 is 26 facilities (however, USEPA-OSW-HWID dropped three of these 26 chemical manufacturing facilities from the scope of the listing proposal because they reportedly do not produce CAHCs). Number of "data points" is synonymous with number of "observations".

For added confidentiality protection, data aggregations (i.e. computed means, medians and standard deviations) are not displayed for datafields for which there are less than three responses.

The resultant ***masked survey data*** are shared in this document to provide the public with as much ***transparency*** to the analyses and supporting data in this document as possible. This transparency objective is consistent with Office of Management and Budget guidelines to Federal agencies for the design and content of regulatory analyses.[18] Readers may consult the "Listing Background Document" to this listing proposal for additional information about the design and contents of the Section 3007 survey administered by USEPA-OSW in support of this listing proposal.

IV.D. What are the Characteristics of CAHC Manufacturing Facilities Subject to this Listing?

USEPA-OSW identified a subset of industrial facilities relevant to the scope of the listing proposal, according to both the (a) types of chemical products manufactured, as well as the (b) types of industrial wastestreams generated from the chemical manufacturing processes. USEPA-OSW administered a written questionnaire (RCRA Section 3007 survey) initially in 1992, with a follow-up in 1997, to collect descriptive information about the chemical and waste handling operations at these facilities. USEPA-OSW identified a total of 28 facilities in the 1992 survey, and a total of **26 facilities** in the 1997 follow-up survey (two facilities closed). However, OSW-HWID estimates that only **23 facilities** are potentially relevant to this listing proposal, because of additional plant closures, de minimus CAHC production volumes, and a double-counted facility. The exhibits contained in Attachment B to this document provide summaries of the 1997 survey data.

As displayed in Exhibit B-1 of Attachment B, the 23 relevant CAHC manufacturing facilities surveyed in USEPA-OSW's 1997 survey, employ **18,970 employees** in these 23 facilities (although the total employment associated with the parent companies which own these facilities is much larger, estimated in Exhibit G-1 at about **526,700 employees**). These 23 facilities are located in the following **eight states** (number of CAHC manufacturing facilities in parenthesis):

• Kansas (n = 1) • Maryland (n = 1) •Tennessee (n = 1)

[18] Although not explicit in White House Executive Order 12866 "Regulatory Planning and Review" (30 Sept 1993), the Office of Management and Budget (OMB, 11 Jan 1996) published guidelines to Federal agencies for implementing EO-12866, which contain principles for *full disclosure and transparency* of regulatory analyses (refer to: http://www.whitehouse.gov/WH/EOP/OMB/html/miscdoc/riaguide.html#select).

"Analysis of the risks, benefits, and costs associated with regulation must be guided by the principles of full disclosure and transparency. Data, models, inferences, and assumptions should be identified and evaluated explicitly ... Special challenges arise in evaluating the results of an economic analysis that relies strongly upon proprietary data or analyses whose disclosure is limited by confidentiality agreements. In some cases, such data and analysis may be the best, or even the only, means to address an important aspect of a proposed regulation. Nevertheless, given the difficulties that this confidentiality presents to OMB review and meaningful public participation in the rulemaking, agencies should exercise great care in relying strongly upon proprietary material in developing an economic analysis. When such material is used, it is essential that agencies provide as much information as possible concerning the underlying scientific, technological, behavioral, and valuation assumptions and conclusions."

- Kentucky (n = 3)
- Louisiana (n = 10)
- Michigan (n = 1)
- New York (n = 1)
- Texas (n = 5)

These 23 facilities reported in the survey annual production of over 6.9 million metric tons (15.3 billion pounds) of **22 different CAHC products**, of which the identity for 16 CAHCs displayed in Exhibit 16 below, were reported in the survey as non-CBI. Relative to the OSW-EMRAD's estimate of over 38.8 billion pounds (19.4 million short tons, or 17.6 metric tons) of CAHCs produced in 1997, this survey response represents only about **40% coverage rate** of the entire US industry CAHC manufacturing output, although the 23 facilities which provided survey responses represents 100% industry coverage. OSW has not determined the reason for this apparent discrepancy.

EXHIBIT 16

List of non-CBI designated CAHCs Manufactured by 23 Facilities Surveyed by USEPA-OSW in 1997

1	1,1,1,2-tetrachloroethane	9	Hexachlorocyclopentadiene ("Hex")
2	1,1,2-Trichloroethane	10	Methallyl chloride
3	1,3-Dichloropropene	11	Methyl Chloride
4	Allyl chloride	12	Perchloroethylene ("Perc")
5	Chlorinated Methanes	13	Trans1,2-Dichloroethylene
6	Chloroethane	14	Trichloroethylene ("Tri")
7	Chloroprene	15	Vinyl Chloride Monomer ("VCM")
8	Ethylene Dichloride ("EDC" or "Dichloroethane")	16	Vinylidene chloride

IV.E. What are the Characteristics of CAHC Manufacturing Wastes Subject to this Listing?

According to information displayed in Exhibits C-1 and C-2 in **Attachment C** to this document -- which is compiled from data contained in the "Listing Background Document" (refer to the Federal Register announcement) -- USEPA-OSW estimates that the 23 known CAHC manufacturing facilities generated in 1996, over **127 million metric tons** of wastewaters from various different operations at these facilities, and about **11.5 million metric tons** of wastewaters that may be attributed specifically to CAHC manufacturing processes.

The 14 facilities which are known to manufacture EDC and/or VCM, are estimated to generated 120 million metric tons of wastewaters with an associated 104,600 metric tons of treatment residual sludge (from all operations), of which 10.1 million metric tons of wastewaters with an associated treatment residual sludge volume of 6,400 metric tons, are generated by EDC/VCM processes.

However, the responses to the USEPA-OSW's 1997 Section 3007 survey did cover these entire wastewater and wastewater treatment sludge volumes. As summarized in Exhibit B-1 of **Attachment B**, the 23 relevant CAHC manufacturing facilities surveyed in 1997, reported a total of **109 wastestreams** generated by their CAHC manufacturing operations. The annual quantity of waste generated reported in the survey is about **11.6 million metric tons** (25.7 billion pounds), consisting of 11.47 million metric tons (98%) liquid form as ***wastewaters***, and 0.18 million metric tons (2%) semi-solid form as ***sludges***. In relation to the over 6.9 million metric tons in annual quantity of CAHC products manufactured, the overall median ***waste generation rate*** may be estimated from the aggregated 1997 RCRA Section 3007 survey data at 1.7 metric tons manufacturing waste generated, per 1.0 metric ton of CAHC product manufactured (i.e. 11.6 million/6.9 million metric tons).

As displayed in Exhibit 17 below (based on the data from Section A of Exhibit B-2 in Attachment B), there are five sources and physical forms of these wastestreams, most of which (98%) are in liquid form as wastewaters, and only a relatively minor fraction (<2%) of the 109 wastestreams are in solid form:

EXHIBIT 17:

Summary of Physical Form of 1997 Survey-Reported CAHC Manufacturing Wastestreams

Source/type of Wastestreams Generated	Annual Quantity (metric tons)

A. **Liquid Forms (wastewaters)**:		
• Untreated process wastewater (acid, caustic or neutral)	8.258 million	72%
• Spent scrubber liquid (aqueous and/or organic)	2.179 million	19%
• Miscellaneous wastewaters from equipment washdown, boiler blowdown, and/or other non-process wastewaters	0.803 million	7%
Liquids Subtotal =	11.4703million	**98%**
B. **Semi-Solid Forms (sludges)**:		
• Wastewater treatment sludges (biological or other)	0.177 million	< 2%
• Solids from treatment of other wastes/residuals	0.003 million	< 1%
Solids Subtotal =	0.180 million	**2%**
Total specified in survey =	11.584 million	≈100%
Not specified in survey =	0.068 million	
Total =	**11.651 million**	100%

In addition to the possible (unwanted or unintentional) presence of the CAHCs as **by-product constituents** in wastestreams generated by these industrial processes, the survey facilities reported generation of non-CAHC chemicals as constituents in the CAHC wastestreams (refer to the Risk Analysis Background Document for a listing of non-CAHC constituents). Because of the fact that some facilities ***comingle*** wastestreams from CAHC production units with other wastestreams generated by other industrial operations at the same facility, other constituents not inherently associated with (i.e. generated by) the CAHC manufacturing process may also be present in CAHC manufacturing wastes.

IV.F. How Are CAHC Manufacturing Waste Currently Managed by Facilities Surveyed?

As displayed in Exhibit B-3 of Attachment B, the **109 wastestreams** generated by the 23 CAHC manufacturing facilities included in the scope of this study, are managed primarily using waste treatment ***tank systems*** (data on 58 tanks provided by 15 of the 23 survey facilities) and ***containers*** (17 wastestreams generated by 13 of the 23 facilities). Because the listing proposal as described in the next chapter of this document, addresses wastewaters which are generated and handled in tank systems by all 23 facilities, the characteristics of tank systems are summarized below:

- Tank universe: 58 waste tanks reported in the Section 3007 survey by 15 of the 23 survey facilities included in the scope of this study. Proportionally expanded to the 23 facility "universe" provides an estimate of **about 90** wastewater tanks.

- Tanks per facility: Number of tanks per survey facility ranged from one to over ten, averaging **3.9 tanks per facility** (i.e. 58 survey tanks divided by 15 facilities = 3.9). Some tanks are located off-site from the CAHC manufacturing facilities at privately- or publicly-owned wastewater treatment works (i.e. PrOTWs or POTWs).

- Tank capacity: Total capacity of the 58 wastewater tanks is estimated at 22.045 million gallons, which represents 380,000 gallons average tank size per facility. Extrapolated to 90 total tanks provides an estimate of **34 million gallons** total tank capacity.

- Tank sizes: Imputed "*proxy*" tanks sizes across all 58 survey wastewater tanks range from **45,000 to 775,000 gallons**, with the median size equal to 398,000 gallons (note: to prevent disclosure of CBI tank data from the survey, OSW-EMRAD assigned ***proxy tank sizes*** in this study, by dividing facility total tank capacities, by each facility's total number of tanks, and creating a tank distribution according to nine proxy tank size classes).

- Tank features: 25 of the 58 survey tanks (43%) currently have **covers**, and 35 (60%) have **secondary containment**. Percentage extrapolation to all 90 tanks provides estimates that 39 currently have covers, and that 54 have secondary containment. The survey did not collect data on other tank features such as type and extent of tank covers, tank vents/seals, and tank vent controls.

These two primary WMUs (i.e. tanks + containers), in addition to waste piles, handle over 94% of the quantity of these wastestreams, while two types of secondary WMUs handle 48% of wastestream quantities, and less than 2% of all wastestream quantities are handled using a single type of tertiary WMU. Ultimate, final destination of all wastestreams are handled by eight types of WMUs. All together, eleven different types of WMUs manage these 109 wastestreams at different steps in the ***waste management train*** (i.e. between point of generation and point of final disposal onsite or offsite).

As also displayed at the bottom of Exhibit B-2 in **Attachment B**, in conjunction with the 11 types of WMUs currently used for handling wastestreams generated by these 23 facilities, there are 15 different types of reported ***waste treatment technologies*** also currently used to manage wastes. From a waste management "train" or sequencing perspective, 12 of the treatment technologies are applied as primary steps, five are applied both as primary and secondary steps, and three are applied as only secondary treatment steps. As displayed below in Exhibit 18, seven of these 15 treatment technologies (i.e. aqueous treatment technologies) correspond to managing wastestreams in tanks, four involve "other" waste treatment methods, two involve waste incineration, one involves sludge dewatering, and one involves waste recovery:

EXHIBIT 18

Summary of Current Waste Treatment Technologies	Annual Quantity (metric tons)	
• Aqueous treatment (n = 7 methods)	10.944 million	94%
• "Other" assorted treatment (n = 4 methods)	4.514 million	39%
• Sludge dewatering (n = 1 method)	0.102 million	1%
• Incineration (n = 2 methods)	0.070 million	< 1%
• Recovery (n = 1 method)	0.004 million	< 1%
Reference total waste =	**11.651 million**	100%

The majority (n = 72) of the 109 wastestreams are managed in part of whole onsite, using WMUs located at the same facility, while 37 wastestreams are managed in part or whole at offsite TSDFs (including PrOTWs and POTWs), located at a median distance of **26 miles** away from the generating facility, in **16 different cities** in **six states** (refer to Exhibit B-4 of Attachment B).

In relation to the list of eight states in which the CAHC manufacturing facilities are located, wastes are transported offsite to two other states (Arkansas and Oklahoma) as displayed in Exhibit 19 below. Some facilities ship wastes to offsite WMUs located in cities in the same state as the CAHC manufacturing facility, while other CAHC manufacturing facilities ship wastes to other states (refer to Exhibit B-4 in Attachment B for survey supporting data).

EXHIBIT 19

State Destinations for Offsite Shipment of CAHC Manufacturing Wastewaters & Sludges
(source: Non-CBI data from 1997 Section 3007 Industry Survey)

Receiving State	Annual Quantity (metric tons)	
• Arkansas	10	< 1%
• Louisiana	10,054	< 2%
• Kentucky	CBI	CBI
• Michigan	24,500	3%
• Oklahoma	442	< 1%
• Texas	699,276	96%

Total (not including CBI data) =	734,282	100%

V. ESTIMATED INDUSTRY COMPLIANCE COSTS FOR THIS LISTING PROPOSAL

This chapter presents OSW-EMRAD's estimated costs to industry for compliance with the two specific waste listing categories (with three corresponding proposed RCRA hazardous wastecodes):

- **K173**: CAHC manufacturing process **wastewaters**; and
- **K174 & K175**: CAHC manufacturing wastewater treatment **sludges**.

The purpose of this cost estimation is to provide a **preliminary "order-of-magnitude"** type cost estimate, subject to revision based on public comments, additional information and data collection during the interim period between public announcement of the listing proposal, and formulation of a final listing decision for these wastes.

V.A. What Are the Basic Regulatory Compliance Requirements of a RCRA Listing?

Under Subtitle C, RCRA imposes a number of unique regulatory compliance requirements for industrial hazardous waste management, on facilities which generate, transport, treat, store, and/or dispose of RCRA hazardous wastes (unless specifically exempt).

In general terms, RCRA waste management requirements consist of both administrative and technical requirements, consisting of the following "good housekeeping" and "design, operating and performance" type activities and standards:

- **Hazardous Waste Generator** (if large quantity[19]; 40 CFR **Parts 261 & 262**):
  - Obtain a USEPA facility identification (ID) number.
  - Apply for a RCRA TSDF permit if also treat, store (more than 90 days) or dispose waste.
  - Prepare hazardous waste for transportation.
  - Follow waste accumulation and storage requirements.
  - Manifest hazardous waste (i.e. maintain a written form as part of a controlled tracking system).
  - Keep records and report information to state agencies and regional USEPA offices.

- **Hazardous Waste Transporter** (40 CFR **Part 263**; not including additional USDOT requirements):
  - Obtain a USEPA facility identification (ID) number.
  - Apply for a RCRA TSDF permit if also store waste more than 10 days.
  - Comply with the manifest system initiated by generators.
  - Handle accidental hazardous waste discharges during transport.

- **Hazardous Waste Treatment, Storage and Disposal Facility** (TSDF; 40 CFR **Part 264**):
  - Obtain a USEPA facility identification (ID) number.
  - Apply for a RCRA TSDF permit (renew within ten years and modify when facility changes).

[19]Facilities which generate over 1,000 kilograms of RCRA-listed hazardous waste monthly (or over 1.0 kilogram of RCRA-listed acutely hazardous waste monthly), are defined as "large quantity generators"; facilities which generate between 100 and 1,000 kilograms of RCRA-listed hazardous waste monthly (or less than 1.0 kilogram of RCRA-listed acutely hazardous waste monthly) are defined as "small quantity generators" and are subject to less stringent RCRA requirements (facilities which generate less than small quantity generator amounts are "conditionally exempt" from RCRA. Under these RCRA generator definitions, all CAHC manufacturers in the US (as of 1994 as identified in the USITC annual report Synthetic Organic Chemicals) are "large quantity generators" of CAHC manufacturing wastes.

- Conduct waste analyses.
- Install facility security measures.
- Conduct facility inspections and maintain an operating log for three years.
- Conduct facility personnel training and maintain training records.
- Properly manage ignitable, reactive or incompatible wastes.
- Comply with location standards in siting new TSD facilities.
- Institute emergency equipment, procedures and contingency plan.
- Maintain manifest system records, and provide to state/regional offices.
- Monitor groundwater (if landfill, land treatment, waste pile, or surface impoundment unit).
- Create facility closure and post-closure care plans.
- Provide financial accountability instruments for facility closure/post-closure.
- Manage wastes using technology specified by national standards.
- Follow corrective action for waste spills, releases, groundwater contamination

These are ***minimum Federal national standards*** which may be exceeded by individual state environmental protection regulations.

In addition to the above administrative requirements, RCRA also provides ***waste management unit*** (WMU) technical design and operating standards for hazardous waste storage, treatment and disposal, involving the following ten categories of WMUs:

- Containers and containment buildings.
- Drip pads.
- Land treatment units (landfarms or land application units).
- Landfills.
- Incinerators.
- Boilers and industrial furnaces.
- Surface impoundments.
- Stationary Storage and Treatment Tank Systems.
- Waste piles (for temporary storage and treatment).
- Misc. units (e.g. thermal treatment, underground injection wells, geologic repositories).

For added health and environmental exposure protection in land-based units (i.e. underground injection, landfill, surface impoundment, land treatment), RCRA also provides **waste treatment standards**, which establish either **concentration levels** for hazardous constituents that the waste must meet, or "BDAT" **treatment technologies** that must be performed on the waste before it can be land-disposed (i.e. "Land Disposal Restrictions", 40 CFR 268.40 to 268.48 "Subpart D"). The **BDAT (*best demonstrated available technology*)** is the technology which best minimizes the mobility or toxicity (or both) of the hazardous constituents for a particular waste.[20] RCRA requires that USEPA establish treatment standards for hazardous wastes within six months of promulgating a new listing or characteristic.

In relation to the above RCRA requirements as classified according to the three waste handler categories -- generators, transporters, and TSDFs – all 23 CAHC manufacturing facilities may be potentially classified as waste "***generators***". In addition, 20 of the 23 CAHC manufacturing facilities reported in the USEPA-OSW 1996 Section 3007 survey, that they currently manage part or all of their CAHC manufacturing wastestreams onsite (with three facilities using only offsite waste management services), so these 20 facilities may also be classified as waste "***TSDFs***" as well as waste "generators". The survey did not reveal that any of the 23 facilities currently operate as waste "transporters". Consequently, a RCRA listing proposal may be expected to have differential compliance requirements and effects on the set of 23 facilities which are believed to constitute the

[20] One comprehensive overview of hazardous chemical and waste treatment technologies is provided in Freeman, Harry M, editor, "Standard Handbook of Hazardous Waste Treatment and Disposal", 2nd edition, McGraw-Hill Co., 1998, 1,157pp.

CAHC manufacturing industry as of 1997.

RCRA waste listings require that all relevant industrial generators of waste must determine if their waste is hazardous as defined under the listing, and must oversee the ultimate fate of those wastestreams determined to be RCRA-hazardous.[21] RCRA Subtitle C requires hazardous waste generators to ensure and fully document that hazardous waste they produce is properly identified, managed, and treated prior to recycling or ultimate disposal.

In general, the degree of regulation to which each hazardous waste generator is subject under RCRA, depends to a large extent on how much waste each generator produces every month. With respect to **waste volume** as a criterion, RCRA defines three categories of hazardous waste generators (source: 1998 RCRA Orientation Manual, pp.III-46, III-47; 1.0 kilogram = 2.2 pounds):

- LQGs: >1,000 kilograms (kg) per month (or >1.0 kg "acutely hazardous" waste); statistically, a relatively small number of LQGs generate the majority of the nation's hazardous waste; there were approximately 20,000 LQGs as of 1997.

- SQGs: 100kg to 1,000 kg per month and accumulate <6,000kg at any time; there were approximately 236,000 SQGs as of 1997.

- CESQGs: <100kg per month or <1.0kg "acutely hazardous" waste; there were approximately between 455,000 and 700,000 CESQGs as of 1997.

Based on the findings from the 1997 Section 3007 survey administered to CAHC manufacturers, the 23 facilities identified as constituting the relevant universe of industrial facilities potentially affected by this listing proposal, may all be classified as "LQGs".

V.B. <u>What Are the Main Features of this Specific RCRA Listing Proposal</u>?

The elements of the proposed listing options may be generalized as representing or consisting of **three primary features** involving and affecting the management of industrial hazardous wastes:

- **Affected industrial processes**: Identification of two specific categories of industrial wastestreams as "RCRA hazardous waste" (i.e. process **wastewaters**, and wastewater treatment **sludges**). Such wastestreams are generated by CAHC manufacturing processes involving chemical reactions and operation of chemical plant and equipment, as identified and described in the Federal Register announcement and "Listing Background Document" for this listing proposal.

- **Prescribed WMUs**: "**Conditional" management** restriction of industrial facility handling of proposed listed "hazardous" wastes to specific type(s) of waste management units. WMUs may be operated either onsite by the same company

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[21] Under RCRA, hazardous waste generators are the first link in the cradle-to-grave hazardous waste management system. This system is codified in Parts 260-299 of "Title 40 - Protection of the Environment" of the Code of Federal Regulations (CFR). However, the requirement that generators oversee the fate of hazardous wastes is not explicitly prescribed as a single conceptual piece in the CFR, but is codified implicitly in relation to two unique components of RCRA generator standards, concerning whether hazardous waste is stored, treated, recycled and/or disposed onsite by the generator, or if transported offsite:

- <u>If handled onsite</u>: RCRA's "Pre-transport Requirements" (40 CFR 262.34(b)) require hazardous waste generators who accumulate and store the waste on-site for more than 90 days to comply with RCRA's waste management unit regulations and standards.
- <u>If handled offsite</u>: RCRA's "Manifest" requirements (40 CFR 262.20(b)) require hazardous waste generators who transport the waste offsite to designate on a shipment manifest a receiving facility (primary and alternate) which is permitted to handle RCRA hazardous waste (in accordance with the waste management unit regs and standards).

which owns and operates the CAHC manufacturing facility, or operated offsite from the CAHC manufacturing facilities, either by the same chemical company, or by a commercial waste management company).

• **Prescribed treatment standards**: In conjunction with conditional restrictions on WMUs, restriction of handling of listed "hazardous" wastes in conformance with specific waste treatment standards, in the form of ***BDATs***. The listing-prescribed WMUs and treatment standards taken together constitute sequential waste handling steps (i.e. a waste management "train"). Determination of the ultimate delegation of wastestream management steps between onsite and offsite WMUs is a matter of company financial decision-making, not the RCRA listing itself.

V.C. What are the Specific RCRA Listing Options Under Consideration in this Proposal?

Exhibit 20 presents the **five initial options** formulated for this RCRA listing proposal. The initial options summarized are targeted at process ***wastewaters*** (one initial listing option), and wastewater treatment ***sludges***[22] (five initial listing options) generated during the manufacture of CAHCs. The options are also targeted at certain types of CAHCs product lines: **ethylene dichloride** (EDC), **vinyl chloride monomer** (VCM), and **methyl chloride** and **allyl chloride** (which are mentioned as wastewater treatment sludge listing options but as "No List"). Refer to the Federal Register announcement "Preamble" to the listing proposal, for details of USEPA's "list"/"no list" rationales for each of these CAHC listing options.

In addition to a more generalized listing applicable to many relevant facilities, the sludge category of this listing proposal also targets two specific types of CAHC manufacturing units; one facility which currently uses a particular type of non-hazardous waste management unit (i.e. land application unit), and one facility which currently uses a particular type of industrial process for manufacturing VCM (i.e. involving acetylene feedstock and a mercury catalyst; referred to as the **VCM-A process** in this document).

OSW-EMRAD has costed the initial listing options in this document, according to the: (a) affected annual industry waste volumes, (b) industry waste management requirements prescribed by the listing options, and (c) associated waste management unit cost assumptions developed from secondary sources.[23] The waste quantities and underlying cost computation parameters for the

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[22] "Sludges" are any solid, semisolid, or liquid waste generated from a municipal or industrial wastewater treatment plant, water supply treatment plant, or air pollution control device (e.g. filters, baghouse dust). The quantity and nature of sludge generated relates to the character of the raw wastewater and processing units employed. Combinations of physical, chemical and biological processes are employed in handling sludges. While the purpose in treating wastewater is to remove impurities from dilute solution and consolidate them into a smaller volume of liquid, the objective of processing sludge is to extract water from the solids and dispose (i.e. safely manage) the dewatered residue. The majority of sludge solids from biological wastewater processing are organic with a 60% to 80% volatile fraction. The concentration of suspended solids in a liquid (watery) sludge is determined by straining a measured sample through a glass-fiber filter. Non-filterable residue (i.e. suspended solids) is usually expressed in milligrams per liter or as a weight-percent. For example, dewatering of sludges by mechanical centrifugation may concentrate sludges to 20% solids content (similar to consistency of wet mud or clay), and dewatering by mechanical pressure filtration may increase solids content to 40% (a cake-like or chunky consistency). The method of ultimate disposal and market economics dictate the degree of moisture reduction necessary. The majority of municipal and industrial wastewater sludges are disposed of on land, with about 75% being used as soil conditioner and the remainder buried in landfills. Dewatered raw sludges may also be incinerated generally if the organic solids content is greater than 35%. For additional information about the physical, chemical and treatment properties of sludges, consult Chapter 13 "Processing of Sludges" (pp.569-661) in Viessman & Hammer.

[23] The 1992 and 1997 follow-up Section 3007 industry surveys administered by USEPA-OSW in support of the development of this listing proposal, requested some types of cost data from CAHC manufacturers for their industrial waste management practices. However, many survey respondents claimed CBI status for most of their cost data supplied in the survey. Consequently, for purpose of estimating national industry listing compliance costs for the listing proposal, OSW-EMRAD applied industrial waste management unit cost data in this document derived from prior economic studies in support of RCRA regulation, and pertaining to the management of industrial hazardous and non-hazardous wastes. These prior studies and other secondary data sources are referenced in the Exhibits in Attachments C and D to this document. In most cases, the unit costs applied in this document may be characterized as representing US national averages or medians, rather than as regional- or

industry cost computations for each listing option are provided in **Attachment C** to this document.

Based on the results of the waste sampling and risk analyses described in the "Risk Analysis Background Document", the USEPA-OSW is proposing to designate the following three RCRA industrial hazardous wastecodes for this industry:

- **K173**: Process Wastewaters:
    - Wastewaters from the production of CAHCs, except wastewaters from the mercury catalyst VCM-A process.
- **K174 & K175**: Wastewater Treatment Sludges:
    - K174: Wastewater treatment sludges from production of EDC/VCM.
    - K175: Wastewater treatment sludges from acetylene-based production of VCM (i.e. VCM-A) using a mercury catalyst.

The rationales for USEPA-OSW's selection of these particular listing options are described in both the "Preamble" contained in the Federal Register announcement, and the "Risk Analysis Background Document", available from the RCRA Docket (Information Center) by phone at 703-603-9230, fax at 703-603-9234, website http://www.epa.gov/epaoswer/osw/infoserv.htm#info or walk-in address Crystal Gateway I, First Floor, 1235 Jefferson Davis Highway, Arlington, Virginia 22202. Public assistance in locating RCRA-related documents is also available from the RCRA Hotline at 800-424-9346, or by Internet request at http://www.epa.gov/epaoswer/hotline/index.htm or email to rcra-docket@epamail.epa.gov .

OSW derived the listing options based on the findings of risk analysis modeling. The risk analysis modeled the environmental fate and transport of chemical constituents found in these wastes, for the purpose of deriving probabilistic-based, chronic risks to human health and the environment, associated with current (baseline) waste management practices in this industry. The risk analysis modeled groundwater contamination risks associated with baseline sludge management practices, and modeled air emissions risks associated with baseline wastewater tank management practices.

industry-specific unit costs. A -10% to +30% cost estimation uncertainty range is applied to total industry compliance cost in this document, to simulate possible variation in actual unit costs in the affected entities, compared to the unit costs applied in this document.

EXHIBIT 20: Initial RCRA Listing Regulatory Option Development for 1999 Proposal - Chlorinated Aliphatic Manufacturing Wastes

<table>
<tr><th>Initially Targeted Wastes/Processes</th><th>Initial RCRA Listing Options (n = 6)</th><th>Projected Treatment BDAT</th><th>Projected Management Method</th></tr>
<tr><td rowspan="3">A. Wastewater Treatment Sludge from Ethylene Dichloride and Vinyl Chloride Monomer (EDC/VCM) Production</td><td>conditional listing 1: wastes meeting the description are listed as generated, EXCEPT for wastes that are to be disposed in Subtitle D (or C) landfills.</td><td rowspan="3"><u>numerical stds. for dioxins and arsenic (As)</u> – most likely treatment will be incineration.

(above BDAT only applies for wastes <u>not</u> sent to landfills in contingent option 1, only to wastes sent to LTUs in contingent option 2, and <u>all</u> wastes in standard listing option).</td><td>continued Subtitle D landfill disposal w/out BDAT treatment. The 1 facility currently using an LTU will likely discontinue this practice and switch to landfilling.</td></tr>
<tr><td>conditional listing 2: wastes meeting the description are listed as generated ONLY if they are to be managed in land treatment units (LTUs).</td><td>continued Subtitle D landfill disposal w/out BDAT treatment. The 1 facility currently using an LTU will likely discontinue this practice and switch to landfilling.</td></tr>
<tr><td>standard listing option: wastes meeting the description are listed as generated irrespective of management activity.</td><td>following BDAT treatment, Subtitle C landfill disposal.</td></tr>
<tr><td>B. Wastewater Treatment Sludge from Acetylene-Based VCM Production Using a Mercury Catalyst Process (“VCM-A”)</td><td>List VCM-A sludges</td><td>2 options:

1) BDAT similar to K106 (i.e., RMERC for sludges w/ high total mercury (Hg), numeric Hg standards for low Hg sludge or residue from RMERC); or

2) Mercury (Hg) numeric criteria (TCLP extract) that requires either improved sulfidic treatment of wastewaters, or sludge washing to remove soluble Hg w/ water returned to wastewater system.</td><td>BDAT Option 1 would divert sludges away from current practice of disposal in Subtitle C landfill, to Hg recovery f.b. incineration of residuals.

BDAT Option 2 would add some possible treatment to the sludge prior to disposal in Subtitle C landfill.

Note that current practice for the 1 facility that generates this waste is Subtitle C landfill (their choice).</td></tr>
<tr><td>C. Wastewater Treatment Sludge from Methyl Chloride Production</td><td>“No List” recommendation based on risk analysis (no cost estimates developed).</td><td>N/A</td><td>Continued Disposal in Non-Hazardous Waste Landfill.</td></tr>
<tr><td>D. Wastewater Treatment Sludge from Allyl Chloride Production</td><td>“No List” recommendation based on risk analysis (no cost estimates developed).</td><td>N/A</td><td>Continued Disposal in Non-Hazardous Waste Landfill.</td></tr>
<tr><td>E. Wastewaters from the production of chlorinated aliphatic hydrocarbons, except for wastewaters generated from the production of vinyl chloride monomer using mercuric chloride catalyst in an acetylene-based process</td><td>List wastewaters meeting description.</td><td>N/A</td><td>Wastewater treatment units used to treat chlorinated aliphatic wastewaters must have covers and enclosures, as defined in 40 CFR §265.1081</td></tr>
</table>

V.D. What are the Potential Costs of this Listing Proposal to CAHC Manufacturers?

There are **two categories** of RCRA regulatory compliance costs for CAHC manufacturers:

- Process **wastewater** listing costs.
- Process wastewater **sludge** listing costs.

These costs are ***incremental*** in the sense that all 23 CAHC manufacturing facilities are currently regulated under RCRA (i.e. as chlorinated aliphatic manufacturers via the existing RCRA F025 & F026 wastecodes), and some facilities currently manage most or all of their CAHC manufacturing wastes as hazardous:

- **Currently Regulated by RCRA**: Many of the companies potentially affected by this listing proposal are large companies, and may have other types of chemical manufacturing and processing operations at the same chlorinated aliphatics facility, or at other facilities, which are currently subject to RCRA regulations, from prior RCRA listings for chlorinated aliphatic manufacturing and/or prior RCRA listings directed at other chemicals or industrial processes.

- **Currently Managed as Hazardous**: Based on the survey findings, some chlorinated aliphatic manufacturers manage some or all of the wastestreams from their chlorinated aliphatic production processes in waste management units designed and operated according to RCRA standards. Consequently, this subset of CAHC manufacturers would only be incrementally (and differentially) affected by the proposed listing, in relation to RCRA waste management regulations and standards.

Consequently, this listing proposal will not have a full **incremental impact** on these facilities, and the marginal impact on their existing operations in relation to current RCRA compliance and hazardous waste handling practices, may be less than it otherwise would be if these companies and facilities did not have experience with baseline RCRA waste management practices. Exhibits in Attachment E present the respective annual waste generation quantities for the CAHC manufacturing operations. Some wastestreams are managed as "**dedicated" (segregated) wastes**, whereas others are **comingled (non-dedicated) wastes** with other types of wastes generated from other industrial operations at the same facility.

Basically, incremental compliance costs are estimated in this document by multiplying the following numerical factors: (a) incremental unit costs ($/ton) for compliance with the RCRA listing waste management conditions, times the (b) affected industry waste quantities per facility (tons), times the (c) numbers of affected industry facilities. Cost computation worksheets are provided as a series of Exhibits in **Attachment C** (K174 & K175 sludge management costs), and **Attachment D** (K173 wastewater management costs) to this document.

Industry cost estimates are provided in these two attachments for the **initial listing options** formulated by OSW, however, only the estimated costs for the three proposed new wastecode listings (K173, K174, K175) are summarized in this chapter below. The **waste management requirement costs** estimated in this background document correspond to the following practices:

- **K173: Wastewaters** (cost estimate computations are presented in **Attachment D**):
  - Cover all CAHC manufacturing wastewater tanks which exceed the influent dioxin 1 ng/L (nanogram[24] per liter) concentration ***trigger level*** (one of five alternative engineering control options as specified in the 40 CFR 264/265.1084 "Subpart CC" standards for tanks; note that only tank roof option 1f is costed in **Attachment D**):

[24] Nanogram (ng) = one billionth of a gram (i.e. 1.0 x 10^{-9} grams); 1.0 gram = 0.035 ounce.

(1) Fixed roof with closed vent ($36,000 to $266,000 installation cost per tank), to one of seven control device options:
- (1a) Thermal vapor incinerator.
- (1b) Flare.
- (1c) Boiler.
- (1d) Process heater.
- (1e) Condenser.
- (1f) Carbon absorption ($5,000 to $37,000 installation per tank, plus $20,000 to $145,000 annual O&M per tank).
- (1g) Other demonstrated device.

(2) Fixed roof and internal floating roof.
(3) External floating roof with primary and secondary seals.
(4) Pressure tank with closed system.
(5) Cover or fixed roof with hatch/port/lid seals and gaskets (if tank contents are not mixed, stirred, agitated or circulated).

• **Ancillary tank air emission compliance requirements** (n = 5 components consisting of $2,600 annual paperwork per tank, plus additional dioxin testing cost below):
(1) Tank air emission vent control device performance demonstration.
(2) Tank control system inspection & monitoring.
(3) Tank control system test plan, inspection/monitoring recordkeeping.
(4) Periodic reporting of tank system performance.
(5) Testing to determine dioxin concentration in tank influent wastestreams ($1,500 per waste sampling test).

• **K174 & K175 sludges** (cost estimate computations are presented in Attachment C):

• **K174**: Sludge **incineration** ($625/ton) and **Subtitle C disposal** ($130/ton) of incineration residual for EDC/VCM manufacturing wastewater treatment sludges.

• **K175**: Sludge **retorting recovery** of mercury ($1,284/ton), and **restricted landfill disposal** ($195/ton) of retort residual under: (a) controlled pH conditions (i.e. < 6.0 pH), and (b) with wastes not containing sulfides, for the VCM-A process with mercury catalyst wastewater treatment sludges.[25]

The proposed alternative treatment requirements for wastecodes K173, K174 and K175 are not costed in this document, because no waste quantities are anticipated to require such treatment (which is consistent with the assumptions defined in the Federal Register "Preamble" and "Capacity Analysis Background Document" for this listing proposal).

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[25] One commercial waste management company (Bethlehem Apparatus Company) reported to staff of the USEPA-OSW in Spring 1999 (phone contact), that the retorting treatment (i.e. the 40 CFR 268.42 Table 1 "**RMERC**" treatment technology code) of this particular type of mercury-containing sludge from the VCM-A process, is technically feasible but complicated by the particular chemical form of mercury (i.e. mercuric chloride, mercuric sulfide, or mercuric oxide) contained in the waste and formed during the retorting process, using existing commercial retorting methods. In addition, the commercial availability, location and relative unit cost of providing and shipping to "**condominium landfill cells**" which meet the two proposed **landfill co-disposal restrictions** for retorted K175 sludges (i.e. low pH and no sulfides), was not ascertained by OSW (refer to the "Background Document for Capacity Analysis" identified in the Federal Register for this listing proposal). Consequently, the cost estimate associated with the proposed K175 listing option -- which is based on a national average unit cost estimate of $856/ton for traditional retorting of sludge, and of $130/ton for RCRA Subtitle C hazardous waste landfilling -- has been escalated in this document by a multiplier of 1.5 (i.e. $1,284/ton and $195/ton, respectively), to account for commercial unit cost uncertainty.

All listing options also require CAHC manufacturers to comply with the **permitting and recordkeeping** requirements of RCRA, as identified earlier in this chapter. As noted elsewhere, because of the fact that the 23 CAHC manufacturers are relatively **large and diverse chemical companies**, which are currently permitted and managing other industrial wastes as RCRA "generators", and in some cases also as RCRA "TSDFs", the incremental effect of this listing proposal on these facilities is less than it otherwise would be if facilities were required to "start from scratch" for RCRA permitting and waste management compliance. The incremental labor burden hour costs to the 23 facilities associated with the general RCRA administrative (recordkeeping and reporting) requirements, are separately estimated and presented in the "***Information Collection Request***" (ICR) for this listing proposal. The **$153,400** in average annualized industry paperwork burden costs estimated in the ICR, should be added to the cost estimates of this document, for deriving an estimate of total incremental cost to industry for this listing proposal.[26]

As summarized in Exhibit 21 below, the total industry compliance cost associated with the two waste categories of the listing proposal (i.e. sludges and wastewaters), is estimated at **$2.4 million in average annual cost (non-discounted)**, primarily in the form of annual waste management in conformance with the RCRA Subtitle C treatment standard and WMU disposal requirements. Application of **-10% to +30% cost estimation uncertainty**[27], produces a **cost estimate range of $2.1 to $3.1 million** (refer to Exhibits in **Attachment E** for supporting data and computations):

EXHIBIT 21:
Estimated Industry Compliance Cost for the Listing Proposal
(Note: does not include RCRA paperwork burden costs estimated in the ICR, which should be added)

Proposed Listing Targets (Processes)	Number of Affected Facilities	Annual Metric Tons of CAHC Waste	Estimated Average Annual Equivalent Cost ($millions)
A. **K173: WASTEWATERS**:			
• All CAHC mfg units	23 of 23	11.1 million	$0.813
B. **K174 & K175**: SLUDGES:			
• VCM/EDC in LTU	1 of 23	1,750	$1.333
• VCM-A	1 of 23	120	$0.209
		Total =	**$2.355**
Total AAE cost with -10% to +30% uncertainty applied =			$2.1 to $3.1

The average annual costs above include (a) initial capital cost (annualized at 0% discount rate over a 30-year period with simple division by 30), and (b) average annual operation and maintenance

[26] The 23 July 1999 **Information Collection Request** (ICR) for this listing proposal, provides an estimate of $184,186 in annual industry **paperwork burden cost** (for RCRA recordkeeping and reporting), consisting of: (a) 1,088 in annual labor hours valued at $42,232, (b) $30,778 in annualized tank influent wastewater dioxin lab analysis and tank recordkeeping costs, and (c) $111,176 in other permit modification, documentation, recordkeeping, notification, and records retention costs, to the 23 CAHC manufacturers and to affiliated waste handler (landfill) facilities. To eliminate double counting of cost, the tank-related costs should be subtracted (i.e. $184,186 - $30,778 = $153,408), before adding the ICR paperwork burden cost to the annualized industry cost estimated in this Economics Background Document (tank-related sampling and paperwork burden are also estimated in this EBD). The ICR (nr. 1924.01) is available to the public from a copy may be obtained from the USEPA's Office of Policy Regulatory Information Division, 401 M Street, SW (Mailstop 2137), Washington, D.C. 20460-0003 (phone: 202-260-2740), or may be downloaded off the Internet at http://www.epa.gov/icr .

[27] The Office of Management and Budget (OMB) 11 January 1996 "best practices" guidance for economic analysis of Federal regulations under Executive Order 12866 (30 Sept 1993), acknowledges that there are many possible sources of uncertainty in the accuracy of the quantitative estimation of risks, benefits, and costs. OMB's guidance states that some level of estimation accuracy should be reported, concomitant with the underlying quality of data, models, and assumptions applied in a particular economic study. The **-10 to +30% estimation uncertainty** applied above is based on the "International Recommended Practice Nr. 18R-97" guidelines for cost estimation uncertainty, published 15 June 1998 by the Association for the Advancement of Cost Engineering International (http://www.aacei.org). These guidelines are applicable to engineering, procurement and construction cost estimation for the chemical process industries, and they define **five levels of uncertainty** reflecting varying degrees of purpose, knowledge, and data used in developing cost estimates: (a) -20% to +100% class 5 order-of-magnitude estimate; (b) -15% to +50% class 4 study estimate; (c) -10% to +30% class 3 preliminary estimate; (d) -5% to +20% class 2 definitive estimate; and (e) -3% to +15% class 1 detailed estimate.

costs. The application of alternative discount rates to annualized costs is presented in the next section below.

V.E. <u>What is the Time-Discounted Present Value of Estimated Industry Compliance Costs</u>?

V.E.1. <u>Which Discount Rate is Applied in this Study?</u>
The $2.355 million in average annual compliance cost is a dollar value expressed in ***real or constant dollar magnitude*** (i.e. based on current year 1999 price levels), without time-discounting applied in the computation of average annual equivalent costs. Economic analyses are standardly accomplished using "real" or "constant-dollar" monetary values, rather than in "nominal" or "inflated-dollar" values. In contrast, financial- or accounting-type analyses often apply "inflated-dollar" values in order to, for example, develop and allocate actual funding for future budgets and expenditures, which is beyond the scope and purpose of this Economics Background Document.

However, even though constant dollar values are applied, both economic and financial accounting analyses standardly apply ***discount rates*** to the magnitude of future dollar values. Exhibit E-1 in **Attachment E** displays the computed average annual equivalents of the constant dollar-based annualized cost estimate, at five alternative ***discount rates*** displayed in Exhibit 22 below. These discount rates are all applied to the identical future **30-year *period-of-analysis*** (i.e. years 2001-2030 POA). In applying discount rates, initial lump-sum capital costs are annualized (i.e. spread over future years in the POA), by using the "***Equivalent Uniform Annual Cost***" (EUAC) method, in which capital costs are converted into ***average annualized equivalents*** (AAEs), by multiplying them with a ***capital recovery factor*** CRF= [dr(1+dr)^n] / [((1+dr)^n)-1], in which dr= discount rate, and n= number of future years in period-of-analysis applied in the study:

EXHIBIT 22

<u>Average Annualized Equivalent Compliance Cost at Alternative Discount Rates</u>

Discount rate	Average Annual Equivalent (AAE) Cost ($ millions)
0% (i.e. no discounting)	**$2.355**
3%	$2.378
5%	$2.396
7% (1992 OMB Circular A-94 required rate)	**$2.417**
10% (1972 initial version of OMB Circular A-94)	$2.450

The Office of Management and Budget (OMB) has a "Discount Rate Policy" which requires Federal agencies to use **7.0% discount rate** for the purpose of conducting benefit-cost and cost-effectiveness, and lease-purchase studies of Federal activities and programs, as stated in OMB's 29 Oct 1992 Circular Nr. A-94 (p.9). However, OMB also specifies that such studies "should show the sensitivity of the discounted net present value and other outcomes to variations in the discount rate", including "a higher discount rate than 7 percent", which is the purpose of the other four discount rates indicated above. The **3% to 10% range in discount rates** applied in this study is identical to the range defined by the USEPA as relevant to illustrating the sensitivity of present value calculations, in its regulatory impact analysis guidelines (USEPA, March 1991 reprint, Appendix C, p.C4).

At one level of generality, lower discount rates (e.g. <5%) often are classified as **"social" or "economic" discount rates**, and higher discount rates (e.g. >7%) are often classified as **"private" or "financial" discount rates**. There are many references to the derivation, application and interpretation of discount rates in the finance, business accounting, and economics science literature. Because this study is an ***economic study*** rather than a ***financial or accounting study***, there is a rationale for applying lower discount rates; however, all are applied in this background document as a type of ***sensitivity analysis***.

V.E.2 How Many Future Years Define the Period-of-Analysis in this Study?

The **30-year future *period-of-analysis*** (POA) is applied to represent a reasonable future compliance period in order to illustrate and compute the present value of future compliance costs, as an analytical supplement in this study to presenting compliance cost estimates only on an **average annualized equivalent (AAE)** basis. OMB's discount rate guidelines do not specify any particular required or alternative POAs, although OMB (ibid, p.16) does identify two potential candidate POA reference periods for portraying and analyzing future cost streams for capital asset lease-purchase, which extend three or more years into the future:

• **Life cycle cost POA**: The full costs of buying or constructing an asset including the asset's purchase price plus any relevant ancillary services connected with the purchase, offset by an asset's "residual value" at the end of its economic life. In this study, the 30-year POA includes both the (a) initial purchase, delivery and installation costs, plus (b) future annual O&M costs, for waste management engineering controls and other RCRA listing compliance requirements.

• **Economic life POA**: An asset's remaining physical, productive or operating lifetime, beginning when the asset is acquired and ending when the asset is retired from service (not the same as the "useful life" for tax purposes). In this study, the 30-year POA reflects a period which is inclusive of, and may exceed, the expected economic life of the engineering controls and equipment requirements of the RCRA listing proposal.

For example, the source document (USEPA, June 1991, Appendix H) used for developing unit cost data on wastewater tank roofs and emission control devices, indicates that the economic (material) life expectancy of such controls is normally 20 years (however, 20 years is not applied for the tank costs in this study because one other Federal government source cited below (IRS) normally applies a 50-year period for water treatment systems, so a 30-year POA represents a compromise between 20 and 50 years for wastewater tanks). Note that other past USEPA-OSW studies and unit cost reference material (e.g. 1993 unit cost data in EMRAD's "Unit Cost Compendium") typically apply a 20- to 40-year operating lifespan assumption for industrial waste management units; a 30-year POA represents the middle of this lifespan range. The risk assessment modeling conducted in support of this listing proposal also applied a 30-year operating lifetime to the landfill units modeled.

The **30-year** economic analysis POA applied in this study also serves as a complement to four other analytic considerations, unique to the scope and topic of this background document:

• **Historical POA**: The 30-year POA mirrors the different types of historical timeseries data from the 1970s, 1980s, and 1990s, referenced in this study for the purpose of establishing CAHC industry production and other relevant economic trends.

• **Medium-term POA**: The 30-year period represents a "medium-term" economic analysis POA, as compared to a 20-year "short-term" POA, and a 50-year "long-term" POA. These two alternative short- and long-term POAs are defined by the USEPA in "Supplemental Appendix C" (pp.7,8) to its March 1991 reprinted regulatory impact analysis guidelines (which are undergoing revision in 1998-1999).

• **Business asset *class lives***: For income tax reporting purposes, the US Internal Revenue Service (IRS) provides a range of business asset class lives, which represent financial or accounting depreciation recovery periods, taxable lives, or guideline lives. For environmental-related business assets, the IRS specifies a relatively wide range of 10 to 50 year class lives (e.g. plant equipment asset class nr. 49.5 to handle solid waste, and water treatment asset class nr. 49.3, respectively). Refer to the IRS website for its "Publication 946 Appendix B" class life tables http://www.irs.ustreas.gov/prod/forms_pubs/pubs/p9469901.htm .

• **Effect of Discounting**: Finally, a 30-year POA reflects the fact that future monetary values beyond 30-years, are diminished in dollar value when discount rates are applied, as is done in this document. Consequently, extending the number of years in a POA may not necessarily capture more future economic consequences (e.g. costs and benefits) when discounting is applied to future values. To illustrate this effect, the discounted present values (PVs) of $100 at different future years, and at the alternative discount rates applied in this study, are displayed below:

EXHIBIT 23

Illustration of Time-Discounting Effect on Future Monetary Values
($100 illustrative reference value)

	POA	Discounted Value at Alternative Discount Rates				
	(years)	0%	3%	5%	7%	10%
	10	$100	$74.4	$61.4	$50.8	$38.6
	20	$100	$55.4	$37.7	$25.8	$14.9
This study > >	**30**	**$100**	**$41.2**	**$23.1**	**$13.1**	**$5.7**
	40	$100	$30.7	$14.2	$6.7	$2.2
	50	$100	$22.8	$8.7	$3.4	$0.9

V.E.3. How Does this Study Define Future Compliance Cost Streams?

For purpose of introducing a **dynamic element** and a **second explicit uncertainty[28] factor** into estimation of industry compliance costs in this study over a future compliance period-of-analysis (POA) -- this study computes present values of future compliance costs associated with the following four alternative future cost stream scenarios:

• **Scenario #1**: Constant uniform annual cost stream over each year of the POA. This is a simple cost stream scenario of the four alternatives applied in this study.

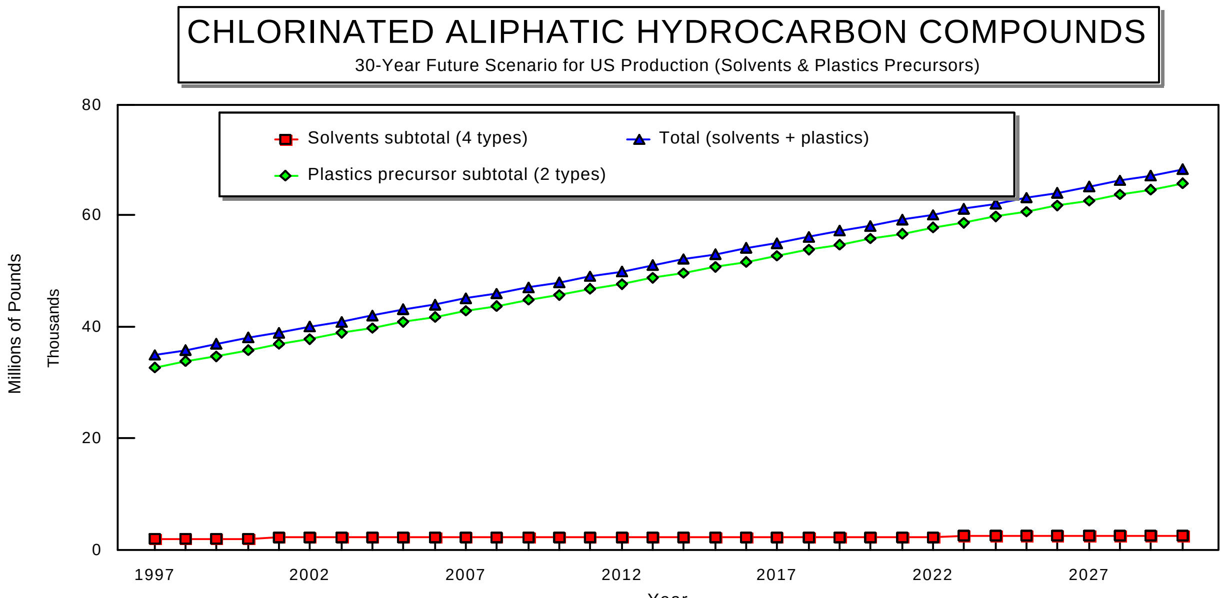
• **Scenario #2**: Production growth annual cost stream. Represents a future 30-year stream of industry costs which grow at an average annual rate of 1.95% over 2001-2030. This projected growth rate displayed in Exhibit 24 below is derived from the 27-year (1970-1996) historical linear regression trendline for US CAHC manufacturing. The implicit assumption is that future annual quantities of waste generated, positively correlate with future growth in US CAHC production, according

[28] Questions have arisen in both the academic community and in regulatory agencies, concerning whether "ex ante" compliance cost estimates (i.e. those developed by a regulatory agency such as the USEPA, or by the affected industry, made at the time a regulation is being proposed) are good predictors of subsequent compliance outlays (i.e. "ex post" costs). Putnam, Hayes & Bartlett (1980) in their study "Comparisons of Estimated and Actual Pollution Control Capital Expenditures for Selected Industries", examine this question for six groups of regulations in five industries: (1) water pollution controls at steam electric utilities; (2) flue gas desulfurization at electric utilities; (3) water pollution control in the pulp& paper industry; (4) water pollution control in the iron & steel industry; and (5) automobile air pollution controls. PH&B found that in these cases, both EPA and industry estimates tended to overestimate actual compliance costs. The average magnitude of compliance cost overestimation was about 110%. In other words, "ex post" actual compliance costs averaged $0.45 for every $1.00 of "ex ante" estimated cost. Refer to http://www.epa.gov/oppe/eaed/eedhmpg.htm for more information about this cost estimation study.

A second more recent study (Harrington, et al., 1998) compared "ex ante" with "ex post" costs for 26 case studies of environmental and occupational safety rules (two involving CAHCs), and concluded that ex ante cost estimates tend to exceed actual (ex post) cost, which the investigators attributed to: (a) unanticipated technological innovations by affected entities, (b) errors in estimating underlying quantities for factors/parameters used in cost computations, (c) modifications to the regulation after cost estimates are prepared, (c) use of maximum rather than mean cost estimates, and (d) asymmetric error correction in responding to concerns of cost underestimation communicated by affected entities.

to the historical US CAHC production growth trend. The largest component of projected US CAHC use, consistent with its historical growth trend, is production of PVC plastics.

Recently there have been concerns about the safety of using PVC plastics in some miscellaneous uses. Three uses have come under public scrutiny largely because of concerns about health risks associated with plasticizers (phthalate esters) in PVC production: (a) PVC toys, (b) PVC medical instruments, (c) PVC in footwear (sources: C&EN 07 Dec 98 p.33; C&EN 12 April 99 p.12; and Internet website



Based on USEPA (OSW-EMRAD) linear-regression extrapolation of 1980-96 historical data from the "US Chemical Industry Statistical Handbook" (CMA).
Note: Production scenario above does not include other chlorinated aliphatic uses produced in smaller quantities.

http://www.greenpeace.org.au/Releases/nike.htm ; respectively). However, the use of PVC plastics for construction materials continue to displace natural products (C&EN, 24 May 99, p.16), and may offset any decrease in miscellaneous demand.

EXHIBIT 24

• **Scenario #3**: Household growth annual cost stream. The third scenario represents an extrapolation of industry compliance costs, based on the US Bureau of Census' projected growth in the number of US households (also refer to Attachment E for supporting computations and data). This scenarios represents an average annual growth rate in compliance costs of 1.07% over the 2001-2030 POA. The implicit assumption is that future annual quantities of waste generated, positively correlate with future growth in US CAHC production, according to future material demand for CAHC-based products by a growing number of US households.

• **Scenario #4**: Decreasing annual cost stream. Applied in this study to contrast with the other three cost stream scenarios; represents an illustrative hypothetical situation in which future compliance costs over the 2001-2030 POA, decrease at an average annual rate of 1.0%, relative to the base year (2001). This scenario may correspond with at least two hypothetical, future industry conditions; that future annual quantities of waste generated decrease because of: (a) industrial process modifications which reduce future waste generation, and/or (b) decreased economic demand for CAHC-based products.

The results for each of the alternative future cost stream scenarios are displayed in Exhibit 26 below (as derived from the computations displayed in Exhibit E-5 in **Attachment E**).

EXHIBIT 25

Summary of Estimated Industry Compliance Costs
at Five Alternative Discount Rates,
and According to Four Alternative Future Compliance Cost Streams
($millions)

Discount Rate	Scenario#1 Constant$	Scenario#2 Growth$	Scenario#3 Growth$	Scenario#4 Decrease$
A. DISCOUNTED PRESENT VALUE:				
0.0%	$68.295	$102.413	$84.597	$54.317
3.0%	$45.630	$64.162	$53.991	$36.678
5.0%	$36.278	$48.995	$41.732	$29.352
7.0%	**$29.675**	**$38.578**	**$33.241**	**$24.130**
10.0%	$22.956	$28.356	$24.819	$18.766
B. AVERAGE ANNUAL EQUIVALENT (PV spread over 30 years with a "capital recovery factor"):				
0.0%	$2.355	$3.414	$2.820	$1.811
3.0%	$2.378	$3.274	$2.755	$1.871
5.0%	$2.396	$3.187	$2.715	$1.909
7.0%	**$2.417**	**$3.109**	**$2.679**	**$1.945**
10.0%	$2.450	$3.008	$2.633	$1.991

In addition to the variability in cost estimation introduced in this document, by applying the -10% to +30% AACEI-recommended cost estimation uncertainty guideline, these four alternative scenarios also introduce a second source of uncertainty, resulting in a cost estimation range at the 7.0% OMB guideline discount rate, of **$1.9 to $3.1 million** in average annualized cost, and **$24.1 to $38.6 million** in present value.

V.F. What is the Ability of Affected Companies to Pay the Estimated Compliance Costs?

V.F.1. Compliance Costs In Proportion to Industry Financial Performance Indicators: For purpose of gauging the magnitude of estimated compliance costs, and for assessing the ability of affected companies to pay for compliance costs, the estimated magnitude of industry compliance costs in aggregate for all listing options in this proposal, are compared below to three alternative, aggregate ***financial benchmarks*** associated with the potentially affected economic sector:

• **Facility Operating Unit Level**: Because of the fact that some potentially affected facilities are large with multiple chemical operating units at the same site location as the unit(s) potentially affected by this listing proposal, the smallest common denominator benchmark is the aggregate financial status of facility CAHC manufacturing sub-units, not necessarily of all chemical and business operations associated with these facilities. "Operating units" may represent multiple distinct (stand-alone) and/or integrated industrial processes within a single facility site.

• **Company Level**: Parent companies which own the facilities, at the next aggregation level up from facility units, facility-specific financial data are not publicly available. However, company-wide data for many of the potentially affected parent companies are available for use as an alternative financial benchmark level.

• **Industry Level**: Industry sectors associated with the affiliate companies which own the CAHC manufacturing facilities. This third level of financial aggregation provides an industry-wide benchmark. The eleven industry sectors associated with the 23 CAHC manufacturing facilities are identified by both SIC and NAICS codes, in Exhibit H-1 of Attachment H at the end of this document.

To this end, costs are compared in this document below to the following **nine financial benchmarks**: two facility operating unit benchmarks, four parent company benchmarks, and three industry-wide benchmarks:

- **Facility Operating Unit Financial Benchmarks** (refer to **Attachment C for K174 & K175**):
  - Production market value (i.e. sales revenue).
  - After-tax profits associated with CAHC production.

- **Parent Company Financial Benchmarks** (refer to **Attachment G** for data sources):
  - Annual company sales revenues.
  - Annual company capital expenditures.
  - Annual company net profits (after tax net income).
  - Company short-term financial credit availability.

- **Industry-Wide Financial Benchmarks** (data from US Bureau of Census sources):
  - Annual final value of sales/shipments.
  - Annual equipment and machinery expenditures.
  - Annual pollution abatement expenditures for waste management.

OSW-EMRAD collected data for the four company financial benchmarks in conjunction with collecting company size data, to determine whether any of the 23 CAHC manufacturing companies are “small businesses” (as discussed in the next chapter of this document). Company financial data collected are displayed in Exhibit G-1 of **Attachment G** to this document. Company data collected reflect all operations associated with all domestic and foreign affiliates for the parent companies which own the 23 CAHC manufacturing facilities.

Because of the fact that public-access financial data are not available for four of the 16 parent companies (for three of the four benchmarks), OSW-EMRAD assigned the median value of the 12 companies with data, to the four companies with missing data, in order to arrive at total values across the 16 companies for each of the financial benchmarks. Based on this imputation method, Exhibit G-2 displays the supporting data from which OSW-EMRAD estimated the following financial benchmarks aggregated for the 16 CAHC manufacturing **parent companies** potentially affected by this listing proposal:

- $163.675 billion in annual sales revenues
- $55.569 billion in annual capital expenditures
- $16.613 billion in annual net profits
- $13.511 billion in short-term credit availability

The financial indicators collected for comparison with estimated compliance costs, are broader than the indicators specific only to the companies affected by the listing options. The following two Standard Industrial Classification (SIC) codes (3-digit level) displayed in Exhibit 26 below -- consisting of 976 companies operating 1,600 facilities -- are associated with about one-half of the chemical manufacturing affiliates/divisions/facilities of the potentially affected 16 parent companies (financial and SIC codes are displayed in **Attachments F and G**), and are used in this document as an industry-wide benchmark level for assessing ability-to-pay compliance costs:

EXHIBIT 26:

Summary of CAHC Manufacturing, Industry-Wide Financial Indicators (mid-1990s data)

Name of Associated Manufacturing Sectors (3-digit SIC Code level)	Number of Companies	Number of Facilities	Industry Employees	Full Production Rate	Annual Sales Revenues (millions)	Annual Machinery Expenditures* (millions)	Annual Solid Waste Expenditures (millions)
282 Plastics & synthetics	341	628	115,100	86%	$59,566.7	$3,431.6	$25.5
286 Organic chems	637	972	125,900	85%	$75,671.9	$5,732.4	$134.7
Total both sectors =	978	1,600	241,000	86%	$135,239	$9,164	$160

Explanatory Notes:
(a) *Expenditures displayed above for machinery & equipment only, excluding buildings and other structures.
(b) Data sources: (b1) Number of companies and facilities from 1992 Census of Manufacturers; (b2) Number of employees, sales, and capital expenditures from the 1996 Annual Survey of Manufacturers; (b3) production rates from 1996 Survey of Plant Capacity, (b4) and solid waste expenditures from 1994 Pollution Abatement Costs and Expenditures; these reports all published by the US Bureau of Census, an agency within the US Dept of Commerce.
(c) Number of employees associated only with SIC code facilities, not inclusive of all parent company affiliates/subsidiaries.
(d) Financial indicators (sales, expenditures) associated only with SIC code facilities, not with all parent company operations.

Exhibit 27 below compares the magnitude of the estimated $2.355 million in annualized industry compliance costs (constant 1999$) for both the sludge and wastewater components of the proposed listing, as a percentage of the values associated with these nine assorted industry financial **"ability-to-pay" (ATP) benchmarks**:

EXHIBIT 27:

Comparison of Estimated Industry Annual Compliance Costs
for the RCRA Listing Options (Wastewater + Sludge Aggregated),
to Nine Alternative Industry "Ability-to-Pay" Financial Benchmarks

Financial Benchmarks	Late-1990s Annual Value ($millions)*	Estimated Industry Compliance Cost** as a Percentage of Benchmark Values
A. Facility Operating Unit Benchmarks (n = 23 affected facilities):		
• Annual value of CAHC product	$4,300	0.05%
• Annual CAHC mfg after-tax net profits	**$218**	**1.1%**
B. Parent Company Benchmarks (n = affected 16 parent companies):		
• Annual sales (all products/facilities)	$163,675	0.0014%
• Annual capital expenditures	$55,569	0.0042%
• Annual profits (all products/facilities)	$16,613	0.014%
• Short-term credit	$13,511	0.017%
C. Industry Benchmarks (primary affected SIC codes = 282, 286):		
• Annual industry-wide sales (all chemicals)	$135,239	0.0017%
• Annual equipment/machinery expenditures	$9,164	0.026%
• Annual solid waste expenditures	$160	1.5%

Explanatory Notes:
(a) * Source: data references and computations described in text of this document prior to table above.
(b) ** Listing option costs potentially affect three groups of operating units: (a) all 23 facilities (K173wastewaters); (b) one EDC/VCM unit using a LTU (K174), and (c) one VCM-A unit (K175).

The above comparison of estimated compliance costs with the various levels of financial benchmarks reveals that at the lowest level (i.e. facility operating unit), annual costs are equivalent to about **1.1 percent of CAHC manufacturing annual net profits**, which indicates that on average, affected operating units would remain financially viable after implementation (i.e. finalization or "promulgation") of the RCRA listing proposal.

On a more detailed evaluation level as displayed in Exhibits C-6 and C-7 of **Attachment C**, the two listing sludge options K174 and K175 which each are only expected to affect one facility in the near term, are estimated to potentially reduce net profits from the EDC/VCM operating units by eight percent and four percent, respectively.

V.F.2. Potential Impact of Compliance Cost on Industry Financial Performance: The ability of companies to absorb increases in ***fixed costs***[29] -- which is in effect the type of financial or accounting-equivalent impact regulatory compliance costs impart on a company -- depends on at least six financial and operating variables unique to each affected facility and company. These **variables are often collectively named company "**cost-volume-profit" (CVP) accounting analysis factors (first five listed below adapted from Horngren & Harrison, pp.963-976):

• **Contribution margin**: Portion of excess of sales revenues over variable costs which contribute to the payment of fixed costs; excess revenues "contribute" to company profit. Management's goal is generally to make the contribution margin as large as possible. Increases in fixed costs offset the existing contribution margin at a given level of company sales volume and product prices.

• **Relevant range**: A usually wide range in sales volume, between which fixed costs remain fixed. The relevant range resembles a stair-step mathematical function. Higher relevant ranges require higher fixed costs. On the other hand, increases in company fixed costs may or may not require offsetting higher sales volumes to maintain target financial performance, depending upon the (a) width of relevant ranges, and (b) magnitude of increase in fixed cost, relative to the next relevant range.

• **Target net income**(profit goal): Incremental amount of sales revenue desired by company management, in excess above the cost of company sales (i.e. the income desired above "break-even sales"). The focus of company managers is often on the company sales level needed to earn a target net income. Increases in fixed costs may make it more difficult for the company to achieve its target net income at a particular level of sales volume and product prices.

• **Margin of safety**: Excess of expected company sales over break-even sales ("break-even" sales is the point where sales revenues equal the total cost (fixed costs plus variable costs) of sales). It is equal to the drop in sales revenues that a company can absorb before incurring an operating loss. A high margin of safety serves as a financial "cushion", and a low margin of safety indicates a "warning" to company managers. Increases in company fixed costs effectively increase operating costs, thereby reducing the company's margin of safety at an existing level of sales. The financial impact of increased fixed costs on a company, depends (a) on its margin of safety before the increase, and (b) the relative magnitude of fixed cost increase. Company managers use the margin of safety to evaluate the financial risk associated with an existing or new business operation/plan.

• **Sales mix**: Combination of products that constitute total sales, which may consist of "high-margin" and "low-margin" products, depending on each product's relative contribution to a company's target net income and margin of safety. Many US CAHC manufacturers produce different types of CAHCs and other chemicals as well, and operate more than one chemical manufacturing facility.

• **Cost structure**: Assorted types, relationships and magnitudes of fixed and variable

[29] There are basically two categories of business financial accounting costs: (a) "fixed costs" do not change in total despite changes in company production or sales volumes (e.g. property/equipment rental, leasing or mortgage, property taxes, some administrative salaries; (b) "variable costs" change in total in direct proportion to changes in production or sales volume (e.g. material, energy, labor costs of goods produced, sales commissions, sales delivery costs); "mixed costs" include both.

costs to a facility, subsidiary company, or parent company, and the ability to make adjustments to the cost structure to compensate for changes in profit performance. Company cost structures are influenced by market structure.

It is also important to state that the above financial benchmark comparisons implicitly assume that all compliance costs are incurred (absorbed) by the affected facility operating units, parent companies and industry sectors, in the form of higher fixed costs. However, as also discussed in this document towards the end of this chapter, some or all of compliance costs may be "passed-through" (i.e. externalized) from one level to the next, for example:

• **Facility externalization** (internal subsidization/absorption): Affected facilities pass a portion or all of their compliance costs onto other business operations, either within the same parent-affiliate company, with other parent-affiliated companies in related markets, and/or across many or all parent-affiliated business units and companies, resulting in internal subsidization within the financial boundaries of the parent company. This possibility depends on the number and financial magnitude of facility and parent company operations.

• **Company externalization** (market/consumer subsidization/absorption): Affected companies pass some or all of their affected facility's compliance costs onto other companies outside the financial boundaries of the parent company, via primary business (market) transactions downstream (input side) and/or upstream (output side), in relation to the affected industry sector. This possibility depends on the number and transaction magnitude of parent company business operations and associated markets, as well as number and transaction magnitude of competitors.

• **Industry externalization** (economy subsidization/absorption): Affected companies (affiliates or the parent) pass a portion or all of their compliance costs onto other companies operating outside the affected industry sector, via secondary/tertiary business linkages with the affected industry sector, within the broader local, regional and/or national economy. This possibility depends on the number, transaction magnitude and degree of input/output/feedback integration of other markets with the local, regional and national economy.

All of the above pass-through levels are affected by whether companies, markets and the economy in general, are growing or contracting. Consequently, the ***ultimate distribution*** of compliance costs is not readily discernable "ex ante" (i.e. before the final listing is implemented), and the financial benchmark percentages should be interpreted as maximum (upper bound) financial effects at each level. Depending on the ultimate distribution attained over time with differing degrees of cost pass-through over three levels, the financial effects may be significantly less than the benchmark percentages computed in the tables above. This "pass-through" possibility further mitigates any adverse financial effect on industry of this listing proposal, thereby reinforcing the conclusion that the affected CAHC manufacturing units may remain financially viable after finalization ("promulgation") of the listing.

V.G. Are There Other Potential Financial or Economic Impacts of this Listing Proposal?

In addition to industry compliance costs described and estimated above, there are at least four other potential effects or impacts associated with this listing, once finalized. This section provides a qualitative description of these other possible impacts. OSW-EMRAD has not attempted to quantify these other effects for two reasons:

• **Not a "significant" regulatory action**: This listing is not anticipated to exceed the $100 million annual "significant" effect threshold defined by the Federal government, for determining whether detailed economic analyses are justified in conjunction with regulatory actions (as explained in the next major section of this document).

• **Not a final regulatory action**: This listing is in proposal stage, not final stage. Depending on the extent of public comments, USEPA-OSW may attempt to quantify "other effects" of this listing.

Listed below, one of these effects is additive to industry compliance costs, one is non-additive or redistributive, one may consist of both additive and non-additive costs, and one is off-setting to industry costs.

• **Landfill leachate treatment costs**: Additional operating costs to owners of hazardous waste management units for landfill leachate treatment. This potential impact is additive to the industry compliance costs estimated in the previous section of this document.

This potential additional cost category was identified by a waste management company just weeks before finalization of USEPA-OSW's final listing rule for petroleum refining wastes (Federal Register, Vol.63, No.151, 06 Aug 1998, p.42173, and Vol.64, No.28, 11 Feb 1999, pp.6806-6814). The issue as described in the petroleum refining waste listing Federal Register notice, is that in some cases (i.e. for some wastestreams from some facilities) non-hazardous waste landfills have historically accepted wastes from these affected industries, and once a listing takes effect (i.e. is finalized), the substantial volumes of leachate generated, collected and managed -- mostly by truck shipment for treatment at publicly owned treatment works (POTWs) -- would also become hazardous by virtue of the RCRA "derived-from rule", even if said landfills no longer accepted waste from the listing-affected industry. Refer to the Federal Register notice for this listing proposal for information about the disposition of this issue (11 Feb 1999 temporary deferral by the USEPA pending further study of this issue).

• **Potential higher prices for some plastics**: Depending on market (supply-demand) conditions within the assorted industrial sectors downstream of the chlorinated aliphatics manufacturing sector, industry compliance costs may be "passed-through" downstream, in the form of higher prices for chlorinated aliphatic products in the form of intermediate inputs into other industrial processes and/or in the form of final products (e.g. polyvinyl chloride (PVC or "vinyl") plastic products). This effect is not additive to industry costs already estimated in the previous section of this document, but represent a possible ***redistributive allocation*** of industry costs over a larger number of facilities, and ultimately in part or whole, to consumers of products derived from chlorinated aliphatic chemicals.

The extent of possible "**pass-through**" of industry compliance costs to consumers depends on consumer "price elasticity of demand" (i.e. the degree to which consumer demand for goods and services decreases (increases), as prices for goods and services increase (decrease)). Consumer price elasticity of demand is a composite behavioral phenomenon reflecting at least three market conditions described below, which are usually dynamic, not static over time. Two of the conditions are usually characterized in the economics literature as "elasticity of substitution demand", and another as "income elasticity of demand". Demand elasticities may be quantified as ratios of the percentage change in quantity of good or service demanded, to the percentage change in price or income.

• **Availability of substitute suppliers**: Extent to which downstream consumers of chlorinated aliphatic chemicals and derived products, may purchase these chemicals at reasonable (lower) prices from foreign suppliers who are not subject to this RCRA listing proposal.

• **Availability of substitute products**: Extent to which downstream consumers of chlorinated aliphatic chemicals, as factor inputs into other industrial processes and/or in the form of derived products, may economically utilize other chemicals and products in place of chlorinated aliphatics. Product substitutability is often a function of technological change and resource availability.

• **Consumer income**: At any given (constant) level of personal, household, business or organization income, as prices for normal goods increase, consumer (downstream) demand usually decreases. However, if income is rising, then demand may remain constant or even increase in response to price increases.

• **International industrial competitiveness**: Regardless of the ability of domestic chlorinated aliphatic producers to absorb internally or "pass-through" compliance costs, because some chlorinated aliphatic chemicals and derivatives are exported by US producers, impacts on company profits or domestic prices may upset the existing balance between domestic production and importation from foreign suppliers.

For example, 95% of CAHCs are used for the production of plastics resins (PVC), of which 10% to 12% of plastics resins produced in the US are exported (based on 1993-1997 Society of the Plastics Industry data: http://www.socplas.org/Industry/stat1.html). In addition to plastics resins, US CAHC producers themselves export two of the CAHC precursors to PVC resin; about 9% of EDC and about 14% of VCM annual US production are exported. Annual imports of EDC are equal to about one percent of domestic production, and imports of VCM are negligible (based on 1993-1997 ChemExpo data: http://www.chemexpo.com/news/PROFILE980216.cfm).

Absorption of compliance costs by domestic producers, in part or in whole, may diminish the financial viability (profitability) of domestic producers and their pricing flexibility as a global competitive instrument. On the other hand, increased domestic supplier prices resulting from cost "pass-through" may increase the attractiveness of foreign suppliers. In either case, domestic producers may stand to loose existing global marketshare in export markets.

The overall net effect of these other impacts depends on the **analytic perspective and framework** applied. There are at least four such alternative perspectives suitable for varying levels of economic assessments, depending on analytic purpose and objectives:

• **Business entity** (financial effects) or consumer perspective (price/availability effects).
• **Specific product/service market**, or **regional perspective** (e.g. isolated supply, demand, employment).
• **National perspective** (e.g. net effects from a "national economic development" framework).
• **Global perspective**.

For example, the consequence of selected perspective may be illustrated with respect to the net-effect of industry cost “pass-through”. If chlorinated aliphatic producers are successful in “passing-through” all compliance costs to downstream industries and consumers without an observable loss in sales volume, the “net-effect” of the listing proposal from a business entity perspective is zero or neutral. However, from a consumer or market perspective, the listing had a negative “net-effect”. On the other hand, if demand for chlorinated aliphatic products is highly price-elastic because of price competitive foreign suppliers, price “pass through” by domestic producers may result in a “net-effect” loss of global market share (i.e. sales volume), if importation of chlorinated aliphatic chemicals increases. In such case, foreign suppliers observe that the listing has a positive “net effect”, whereas domestic suppliers observe a negative “net effect”. The analytic perspective proscribed by the Federal regulatory analysis requirements described in the next section, consists of the first three of these perspectives.

VI. FEDERAL REGULATORY ANALYSIS REQUIREMENTS

This section presents the data, information, and findings required by Federal regulatory agencies such as the USEPA, for compliance with Federal regulatory requirements set forth by the US Congress and by the White House. The relevance and applicability of three standing requirements are described below. This section is limited to only these three because of their potential applicability to economic analysis. As also explained below, other Federal regulatory analysis requirements may apply to this RCRA listing proposal, but only those containing economic analysis provisions are addressed here:

• **Small Entity Impacts (RFA/SBREFA)**: The small entity impact determination set forth by the US Congress in the ***1980 Regulatory Flexibility Act*** (RFA), as amended by the ***1996 Small Business Regulatory Enforcement Fairness Act*** (SBREFA);

• **Industry Cost (EO-12866)**: The $100 million significant economic impact threshold criterion and other economic and regulatory analysis requirements set forth by the Executive Office (White House) in ***Executive Order 12866*** (30 Sept 1993).

• **State, Local, Tribal Government Impacts (UMRA)**: The $100 million significant impact threshold criterion set forth by US Congress in the ***1995 Unfunded Mandates Reform Act*** (UMRA).

VI.A. Regulatory Flexibility Act of 1980 (as Amended by 1996 SBREFA)

VI.A1. What is the Purpose of the RFA/SBREFA?

Recognizing that small business is a major source of competition and economic growth, Congress established a process to be followed by Federal agencies in analyzing how to design regulations that will help achieve statutory goals efficiently without harming or imposing undue burdens on small business.

Congress enacted the ***Regulatory Flexibility Act of 1980*** (RFA, Public Law 96-354) to establish an ***analytic process*** to be followed in determining how public policy issues can best be resolved without erecting barriers to market competition. This law – as amended by Public Law 104-121 "Small Business Regulatory Enforcement Fairness Act of 1996" (29 March 1996) -– requires Federal agencies to recognize differences in the scale and resources of regulated entities, and solicit ideas and comments of small businesses, small organizations, and small governmental jurisdictions, to examine the impact of proposed and existing rules on such entities. Federal agencies are required to solicit and consider ***flexible regulatory proposals*** and to explain the rationale for their actions.

VI.A2. What is the Initial Regulatory Flexibility Analysis?

Whenever a Federal agency publishes a general notice of proposed rulemaking for any proposed rule, the RFA requires that the agency shall prepare and make available for public comment an ***initial regulatory flexibility analysis*** (IRFA, RFA Section 603). Such analysis shall describe the impact of the proposed rule on small entities, and shall be published in the Federal Register at the time of the publication of general notice of proposed rulemaking, and transmit a copy of the IRFA to the SBA. The IRFA shall contain:

• Reasons: Description of agency reasons for the proposed rulemaking action.
• Objectives: Statement of the objectives and legal basis for the proposed rule.
• Entities: An estimate of the number of small entities to which the

proposed rule will apply.

- Requirement: Description of the projected reporting, recordkeeping and other
compliance requirements.
- Alternatives: Description of any significant alternatives to the proposed rule which minimize any significant [adverse] economic impact on small entities.

VI.A3. <u>What is the Final Regulatory Flexibility Analysis</u>?

Furthermore, the RFA requires agencies to publish a ***final regulatory flexibility analysis*** (FRFA, RFA Section 604) when an agency promulgates a final rule, containing the following components (some are similar to IRFA components):

- Need: Statement of the need for and objectives of the final rule.
- Comments: Summary of the significant issues raised by public comments in response to the IRFA.
- Entities: Description and estimate of the number of small entities to which the final rule will apply.
- Requirement: Description of the projected reporting, recordkeeping and other
compliance requirements.
- Impacts: Description of the steps the agency has taken to minimize the significant [adverse] impact on small entities, including a statement of the factual, policy and legal reasons for the regulatory alternative selected in the final rule.

VI.A4. <u>What is the Small Business Impact Determination Made in this Study</u>?

RFA Sections 603 (IRFA) and 604 (FRFA) shall not apply to any proposed or final rule if the head of the agency certifies that the rule will not, if promulgated, have a ***significant*** [adverse] economic impact on a ***substantial*** number of small entities. However, the RFA does not define the words "significant" and "substantial". Consequently, in its initial internal agency guidance for implementation of the RFA, the USEPA advised its program offices to prepare IRFAs and FRFAs for any rule that would have "any impact" on "any number" of small entities. but relaxed this position in its 1997 guidance in response to SBREFA:

> "Prior to the enactment of SBREFA [in 1996], EPA exceeded the requirements of the [1980] RFA by instructing regulatory managers to prepare regulatory flexibility analyses for every rule that would have <u>any</u> impact, no matter how minor, on <u>any</u> number, no matter how small, of small entities. It remains our policy that program offices should assess the impact of every rule on small entities and minimize any impact to the extent feasible, regardless of the size of the impact or number of small entities affected. In view of the changes made by SBREFA, however, the Agency has decided to implement the RFA as written; that is, regulatory flexibility analyses as specified by the RFA will **not** be required if the Agency certifies that the rule will not have **significant** economic impact on **a substantial** number of small entities. This approach will allow EPA to manage its scarce resources such that the Agency can continue considering the potential small entity impacts of all its rules while preparing full regulatory flexibility analyses for those rules warranting such analyses under the RFA." (Source: USEPA's "Interim Guidance for SBREFA and RFA", 05 Feb 1997).

Agencies shall publish "no impact" certifications in the Federal Register at the time of publication of the general notice of proposed rulemaking and at the time of the final rule. This section provides the factual basis to this study's ***negative small business impact determination*** -- i.e. the chlorinated listing proposal ***will not*** have a significant [adverse] impact on a substantial number of small entities -- in accordance with the above RFA requirements. The factual data/information sources consulted by OSW-EMRAD for this determination are described below (and in **Attachment G**).

VI.A5. What is the Applicable Definition of Small Business?

The **Small Business Administration** (SBA) defines a small business to be one that is independently owned and operated and which is not dominant in its field of operation. In determining what is a small business, the SBA definition varies from industry-to-industry to the extent necessary to reflect industry differences.

From the inception of the SBA, the fundamental question arose as to what numerical definition of small business should be used on an industry-by-industry basis. This numerical definition is called the "**Size Standard**" and is almost always stated in either (a) number of employees or (b) average annual receipts (i.e. gross sales revenues). SBA's size standards define the maximum size that a firm, including all of its ***affiliates***, may be for eligibility as a small business.

The appropriate calculation of a firm's size includes the employees or receipts of all affiliates. Affiliation with another business concern is based on the power to control, whether exercised or not. Such factors as common ownership, common management and identity of interest (often found in members of the same family), among others, are indicators of affiliation. Power to control exists when a party or parties have 50 percent or more ownership. It may also exist with considerably less than 50 percent ownership by contractual arrangement or when one or more parties own a large share compared to other parties. The affiliated business concerns need not be in the same line of business.

- **Number of employees**: The number of employees of a firm is its average number of persons employed for each pay period over the firm's latest 12 months. Any person on the payroll must be included as one employee regardless of hours worked or temporary status. The number of employees of a firm in business under 12 months is based on the average for each pay period it has been in business.

- **Annual Sales Revenues**: Gross annual receipts (i.e. sales revenues) are averaged over a firm's latest three completed fiscal years to determine its average annual receipts. "Receipts" means the firm's gross or total income, plus cost of goods sold, as defined by or reported on the firm's Federal Income Tax return. The term does not include, however, net capital gains or losses, nor taxes collected for and remitted to a taxing authority if included in gross or total income. The firm may not deduct income taxes, property taxes, cost of materials or funds paid to subcontractors. If a firm has not been in business for three years, the average weekly revenue for the number of weeks the firm has been in business is multiplied by 52 to determine its average annual receipts.

Size standards define the maximum size that a firm, including all of its domestic and foreign affiliates (subsidiaries), may be for eligibility as a small business concern for most SBA programs, and for purpose of complying with the small entity requirements of the 1980 RFA. The SBA has established two widely used ***small business size standards***:

- Employees: No more than ***500 employees*** for most manufacturing and mining industries.

- Sales: No more than ***$5.0 million*** in average annual receipts (sales revenues) for most nonmanufacturing industries.

For approximately 75 percent of the manufacturing industries, the size standard is 500 employees. Many four-digit SIC code sectors within the manufacturing sector have a 1,500-employee size standard, and the balance have a size standard of either 750 or 1,000 employees. The SBA annually publishes its small business size standards in the Federal Register according to four-digit

SIC codes.[30]

VI.A6. What Databases Were Consulted to Determine Business Size?

OSW-EMRAD first attempted to access the US-SEC's **"EDGAR" database** (via Internet). Under the Securities Exchange Act of 1934, Congress created the Securities and Exchange Commission (SEC). The SEC is an independent, nonpartisan, quasi-judicial regulatory agency. The SEC's mission is to administer federal securities laws and issue rules and regulations to provide protection for investors and to ensure that the securities markets are fair and honest. This is accomplished primarily by promoting adequate and effective disclosure of information to the investing public.

A primary means of accomplishing these objectives is disclosure of financial information by registering offers and sales of securities. Most offerings of debt and equity securities issued by corporations, limited partnerships, trusts, and other issuers must be registered. Registration is intended to provide adequate and accurate disclosure of material facts concerning the company and the securities it proposes to sell. In general, registration requirements apply to securities of both U.S. and foreign companies or governments sold in U.S. securities markets. There are, however, certain exemptions. All companies whose securities are registered on a national securities exchange, and, in general, other companies whose assets exceed $5,000,000 with a class of equity securities held by 500 or more persons, must register such securities. This registration establishes a public file containing material financial and business information on the company for use by investors and others, and also creates an obligation on the part of the company to keep such public information current by filing periodic reports on Forms 10-Q and 10-K, and on current event Form 8-K, as applicable.

In addition, if registration under the 1934 Act is not required, any issuer who conducts a public offering of securities must file reports for the year in which it conducts the offering (and in subsequent years if the securities are held by more than 300 holders).

EDGAR, the public access "Electronic Data Gathering, Analysis, and Retrieval" system, performs automated collection, validation, indexing, acceptance, and forwarding of submissions by companies and others who are required by law to file forms with the U.S. Securities and Exchange Commission (SEC). The SEC's "***Form 10-K***" is the annual report that most reporting companies file with the Commission. It provides a comprehensive overview of the registrant's business, including number of employees and financial information as required for the SBA size determination. The report must be filed within 90 days after the end of the company's fiscal year. Companies that have fewer than 500 investors and less than $10 million in net assets are not required to file annual and quarterly reports with the SEC. There are also other alternative sources of business information, but most are proprietary. Four privately-held companies were not listed in the SEC-EDGAR database. In these cases, OSW-EMRAD collected the required business data from either company Internet websites (if available) or company telephone contacts.

VI.A7. What Are the Findings of the Small Business Determination?

The findings from OSW-EMRAD's query of the SEC-EDGAR database are displayed in Exhibits G-1 and G-2 in **Attachment G**, for the 16 parent companies potentially affected by this RCRA listing proposal. Some companies on this list represent more than one potentially affected facility (i.e. 23 chlorinated aliphatic manufacturing facilities in the US are owned/operated by these 16 parent

[30] In contrast to SBA's 500 to 1,500 number of employee range for defining small business size standards according to SIC codes, the US Department of Commerce and the Chemical Manufacturers Association define four company size categories according to the following number of employees, in reference to manufacturing industries in two-digit SIC codes 20xx to 39xx (source: CMA, 1997, p.87):

Very small-size companies = 1 to 19 employees. Small-size companies = 20 to 99 employees.
Medium-size companies = 100 to 499 employees. Large-size companies = 500+ employees.

According to these size categories, all sixteen of the chlorinated aliphatic manufacturing companies would be classified as "large companies" with over 500 employees.

companies).

SBA's SIC code "number of employees" size standard applies to 15 companies, and SBA's SIC code "annual sales revenues" size standard applies to one company (with SIC code 1400). As displayed in Exhibit G-1, **only one parent company may be classified as a "small business"** with 750 employees, relative to the 1,000 employee SBA size standard associated with its primary four-digit SIC code 2869 (which is NAICS code 32511). The parent company median size across the sixteen companies is *8,600 employees*, with median annual parent company *sales revenues of $2.06 billion*. The total number of domestic and foreign employees for these 16 parent companies is about **527,000**, with total annual sales estimated at **$163.7 billion**.

Because both the 1980 RFA and USEPA's 1998 guidelines for compliance with the RFA specify that the RFA regulatory analysis requirements shall apply to regulatory actions affecting a "substantial number" of small entities, ***the RFA requirements are not applicable to this RCRA listing proposal****,* based on the fact that only one small business is potentially affected (i.e. not a "substantial" number of small businesses).

VI.B. What Are the Requirements Set Forth in Executive Order 12866?

A second set of Federal regulatory analysis requirements is set forth in Executive Order 12866 of 30 September 1993. This Order consists of three main sections (additional details on EO12866 and other Executive Orders, are available via the Internet at http://www.legal.gsa.gov/legal1geo.htm):

- Objectives: Four regulatory process reform objectives.
- Principles: 12 regulatory principles.
- Guidelines: Three agency guidelines, one of which contains six agency procedures for development of regulatory actions.

The purpose and philosophy of this Order is (bracketed numbers added for emphasis):

> "Federal agencies should promulgate only such regulations as [1] are required by law, [2] are necessary to interpret the law, or [3] are made necessary by compelling public need such as material failures of private markets to protect or improve the health and safety of the public, environment, or the well-being of the American people." (EO-12866 Section 1(a)).

This RCRA listing proposal conforms to all three of the Order's regulatory conditions, as explained by the following corresponding points (numbered below to coincide with bracketed numbers in the EO-12866 excerpt above):

(1) **Required by law**: As a Federal law, RCRA is a ***statutory authority*** provided to the USEPA by Congress for the express purpose of promulgating regulations and standards concerning the proper management of hazardous waste. USEPA's RCRA industrial waste listing regulations are required by Congress (RCRA, Subtitle C, Section 3001).

(2) **Interpret the law**: Congress only provided ***general guidelines*** and ***broad terms*** in RCRA for the waste management program envisioned by Congress, and directed EPA to interpret, develop and promulgate details in the form of waste management regulations. These Congressional law directives are also contained in RCRA, Subtitle C, Section 3001.

(3) **Compelling public need**: This listing proposal compensates for the failure of the Nation's market-oriented, socio-economic system, to provide for protection of public and ecosystem health, as described in the Risk Analysis Background Document accompanying this listing proposal (available from the RCRA Docket by phone 800-

424-9346 or via Internet at http://www.epa.gov/epaoswer/hotline/index.htm).

In addition to ***general philosophy*** and principles, the EO-12866 also sets forth the following ***specific philosophy*** directed at the design and application of economic analysis in support of Federal regulatory actions (bracketed numbers added for emphasis):

> "In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including [1] the alternative of not regulating. Costs and benefits shall be understood to include both [2] quantifiable measures (to the fullest extent that these can be usefully estimated) and [3] qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that [4] maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach." (EO-12866 Section 1(a)).

OSW-EMRAD designed the scope and contents of this Economic Background Document to address only portions of two of the four elements of the Order's specific analytic philosophy: quantifiable measurement of costs, and qualitative measurement of costs. This economic study does not address all four elements because the Order allows other statutory regulatory approaches. As a regulatory action, this RCRA listing proposal corresponds to "another regulatory approach", as established by Congress and evidenced by the following **three elements of USEPA's RCRA statutory authority** (pertinent key phrases italicized):

- **RCRA National Policy**: "The Congress hereby declares it to be the national policy of the United States that, wherever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. Waste that is nevertheless generated should be treated, stored, or disposed of ***so as to minimize the present and future threat to human health and the environment***." (SWDA, Section 1003(b)).

- **RCRA Listing Criteria**: "[T]he [USEPA] shall ... develop and promulgate criteria for identifying the characteristics of hazardous waste, and for listing hazardous waste, which should be subject to the provision of this subtitle, ***taking into account toxicity, persistence, and degradability in nature, potential for accumulation in tissue, and other related factors such as flammability, corrosiveness, and other hazardous characteristics***. Such criteria shall be revised from time to time as may be appropriate." (SWDA, Section 3001(a)).

- **RCRA Hazardous Waste Generator Standards**: "[T]he [USEPA] shall ... promulgate regulations establishing such standards applicable to generators of hazardous waste identified or listed under this subtitle, ***as may be necessary to protect human health and the environment***." (SWDA, Section 3002(a)).

The above RCRA statutory authorities do not require the application of a non-regulatory approach, nor do they require quantification of either benefits or net benefits in the establishment of RCRA listings and generator regulations. Collectively, these three RCRA statutory elements represent "another regulatory approach" to the approach described in EO-12866 -- one centered around protection of human health and the environment through analysis of waste characteristics -- in contrast to the cost-benefit regulatory approach described in EO-12866. For this reason, the chlorinated aliphatics listing proposal and this Economic Background Document do not consider a non-regulatory approach, and do not explicitly apply a cost-benefit analytic approach, in line with the orientation of EO-12866.[31]

VI.B.1. <u>What are the Specific Economic Analysis Requirements in EO-12866</u>? Section 6(a) of EO-12866 sets forth three Federal agency responsibilities, in the form of guidelines applicable to all regulatory actions (both new and existing regulations). The third guideline contains six agency procedures, three of which contain instructions to Federal agencies to perform particular types of economic analyses. These three guidelines and procedural requirements are summarized below (numbered and lettered below to correspond with the notation in EO-12866):

(1) **Public participation**: Provide meaningful public participation in the regulatory process; before issuing a notice of proposed rulemaking, seek to involve those who are intended to benefit and those expected to be burdened by an regulation; afford the public a meaningful opportunity to comment on any proposed regulation of not less than 60 days; explore consensual mechanisms for developing regulations including negotiated rulemaking.

(2) **Regulatory officer**: Federal agencies shall designate Regulatory Policy Officer who shall be involved at each stage of the regulatory process to foster the development of effective, innovative, and least burdensome regulations.

(3) **Six agency procedures**: Federal agencies shall adhere to six procedures in a regulatory action (listed A,...,F below). Those procedures specific to economic analysis are indicated along the left margin by **"> >" double arrows**:

(A) Provide the Office of Management and Budget (OMB) with a list of planned regulatory actions.

(B) For "significant" regulatory actions, provide OMB with the following information:

(i1) The text of the draft regulatory action.

(i2) Description of the need for regulation.

(i3) Explanation of how the regulation will meet the need.

> > (ii1) Assessment of potential costs and benefits of regulatory action.

(ii2) Explanation of how the regulatory action is consistent with statutes.

(ii3) Explanation of how the regulatory action promotes the President's priorities and avoids undue interference with State, local and tribal governments.

(C) For "significant" regulatory actions, provide OMB with the following information:

> > (i) Assessment and quantification of anticipated benefits from regulatory action (e.g. promotion of private market efficiency,

[31] Although provision is made in EO-12866 for "alternative regulatory approaches" to cost-benefit and net-benefit type analysis, the Office of Management and Budget's (OMB's) 11 Jan 1996 guidelines to Federal agencies for complying with EO-12866, reaffirm its philosophy and principles, particularly with respect to providing regulatory alternatives even when limited by Congressional statute:

"The amount of analysis (whether scientific, statistical, or economic) that a particular issue requires depends on ... the nature of the statutory language and the extent of statutory discretion ... In particular, a less detailed or intensive analysis of the entire range of regulatory options is needed when regulatory options are limited by statute. Even in these cases, however, agencies should provide some analysis of other regulatory options that satisfy the philosophy and principles of the Executive Order [EO-12866], in order to provide decisionmakers with information for judging the consequences of the statutory constraints."

Additional information about the design of the methodology for this RCRA listing proposal – and the initial identification and ultimate selection of the regulatory options contained in this proposal in light of both EO-12866 and OMB's guidelines – is provided in the Federal Register preamble and other background material identified in the preamble.

enhancement of health and safety, protection of natural environment, reduction of discrimination or bias).

> > (ii) Assessment and quantification of anticipated costs from regulatory action (e.g. direct costs to government and businesses, adverse effects on private market efficiency, adverse effects on health, safety and natural environment).

> > (iii) Assessment of costs and benefits of feasible alternatives to the planned regulation identified by the agency or the public (including non-regulatory actions).

(D) Provide OMB with sufficient time to review regulatory actions.

> > (E) Provide the public with information specified in (B) and (C) above.

(F) Provide all information to the public in plain understandable language.

The expression "significant regulatory action" is defined in EO-12866 (Section 3(f)(1)) as constituting any regulatory action that is to have ***$100 million in annual effect*** on the national economy.

VI.B.2. <u>How Does this Economics Document Conform to the Framework of EO-12866</u>?

Because of the facts that: (a) this listing proposal is based on another regulatory approach than specified by EO-12866, and (b) the anticipated annual effect of this RCRA listing proposal is less than $100 million nationwide, this listing proposal does require the application of a cost-benefit and net-benefit economic methodology, nor does this listing qualify as a "significant regulatory action" as defined by EO-12866.

Consequently, this "Economics Background Document" does not adhere to the analytic methodology and to all of the economic analysis requirements set forth in the Order (as summarized above). Specifically, this economic study does not attempt to (a) quantify the anticipated health and environmental benefits of this listing proposal, nor does it attempt to (b) quantify anticipated net benefits (i.e. benefits minus costs).

VI.B.3. <u>Is this RCRA Listing Proposal a "Significant" Regulatory Action</u>?

For the reasons stated above, this listing proposal does not conform to all of the economic analysis requirements specified in EO-12866. However, it is possible to compare the **anticipated industry costs** of this listing proposal -- as described and quantitatively estimated in the prior chapters of this document -- to the $100 million annual "significant" effect threshold defined in EO-12866. The estimated **$2.417 million in average annual compliance costs** (discounted over a 30-year period-of-analysis at 7.0%) to the chlorinated aliphatics industry for the RCRA listing options considered in this proposal, are less than the EO-12866 "significant" regulatory action threshold. Consequently, it is apparent that this listing proposal is not expected to have a "significant" annual impact on the US economy as defined according to the EO-12866 threshold.

VI.C. <u>What are the Economic Analysis Requirements in the Unfunded Mandates Reform Act of 1995?</u>

VI.C.1. <u>What is UMRA's General Philosophy and Purpose</u>?

The third Federal regulatory analysis requirement considered in this Economic Background Document, is the US Congress' "Unfunded Mandates Reform Act of 1995" (UMRA). The overall philosophy of UMRA is to curb the practice of imposing unfunded Federal mandates (i.e. laws and regulations without adequate Federal funding for implementation), on States, local and tribal governments, and the private sector. Section 2 of UMRA's preamble contains eight purposes in line with its philosophy, two of which pertain directly to economic analysis:

Section 2(7)(B): "[P]repare and consider estimates of the ***budgetary impact*** of regulations containing Federal mandates upon State, local, and tribal governments and the private sector before adopting such regulations, and ensuring that small governments are given special consideration in the process."

Section 2(8): "[T]o begin consideration of the ***effect*** of previously imposed Federal mandates, including the impact on State, local, and tribal governments of Federal court interpretations of Federal statutes and regulations that impose Federal intergovernmental mandates."

The scope of the present Economic Background Document conforms to UMRA's *budget impact* assessment philosophy, in that in the current ***proposal stage***, this document includes an estimation of the potential compliance costs to the chlorinated aliphatics manufacturing industry (i.e. the affected segment of the private sector) before adopting a final rule.

VI.C.2. <u>What Are UMRA's Specific Economic Analysis Requirements</u>?

Title II of UMRA contains four specific procedural and analytic requirements targeted at Federal regulatory agencies, of which two are specific to economic analysis. UMRA's other titles (I, III, and IV) pertain to Congress itself, the Advisory Commission on Intergovernmental Relations, and to the Federal Judiciary.

The overall orientation of UMRA's Title II Federal regulatory agency requirements – as stated in Section 201 of Title II -- is that agencies shall assess the effects of regulatory actions on State, local, and tribal governments, and the private sector, unless otherwise prohibited by law or if regulations specifically incorporate requirements set forth in law. UMRA's four Title II requirements are:

Section 202: Written Statement for "Significant" Actions: Before promulgating any general notice of proposed rulemaking or final rule that may result in the expenditure by State, local and tribal governments in the aggregate, or by the private sector, greater than $100 million (adjusted annually for inflation) in any one year, the sponsoring Federal agency shall prepare a written statement containing (economic analysis requirements indicated along the left margin with **"> >" double arrows**):

(1) Identification of the Federal law provision for the regulatory action.

> > (2) Qualitative and quantitative assessment of anticipated costs and benefits.

(a) analysis of availability of Federal financial assistance to pay for costs.

(b) analysis of availability of Federal resources to carry out the mandate.

> > (3) Estimates of (a) future compliance costs and (b) any disproportionate budgetary effects upon regions of the Nation or particular State, local or tribal governments, urban or rural or other types of communities, or private sector segments.

> > (4) Estimates of the effect on the national economy.

(5) Description of the agency's consultation with elected representatives of affected State, local and tribal governments.

Section 203: Small Government Agency Plan: Before establishing any regulatory requirements that might significantly or uniquely affect small governments, agencies shall have developed a small government consultation plan.

Section 204: State, Local and Tribal Government Input: Agencies shall develop an effective process to permit elected officers of State, local and tribal governments to provide input in the development of regulatory proposals.

> > **Section 205**: Least Burdensome Option: Agencies shall identify and consider a reasonable number of regulatory alternatives for "significant" actions, and from those alternatives select the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule.

VI.C.3. Does the Analysis Presented in this Document Comply with UMRA?

The "significant" trigger threshold defined in Section 202 of UMRA, is almost identical to the "significant" threshold defined in Executive Order 12866, per the discussion in the prior section of this document. Consequently, based on the same rationale that the estimated average annual private sector (i.e. industry) costs of this listing proposal, are less than the designated $100 million UMRA single year trigger threshold, the economic analyses associated with UMRA's written statement (Section 202) and least burdensome option procedures (Section 205) are not required for this listing proposal. The benefit-cost analysis provisions of UMRA do not apply.

VI.D. Why are Only Three Federal Regulatory Requirements Addressed in this Document?

Besides the three regulatory development requirements addressed in this document above, there are at least ten other standing Federal regulatory development requirements contained in Congressional laws and White House Executive Orders (EOs), including:

- US Congress, Administrative Procedures Act of 1966 (PL 89-554, 80 Stat.631).
- EO-12778: Civil Justice Reform, 23 Oct 1991.
- EO-12898: Environmental Justice, 11 Feb 1994.
- US Congress, National Technology Transfer & Advancement Act of 1995 (PL104-113).
- US Congress, Paperwork Reduction Act of 1995, 01 Oct 1995.
- US Congress, Congressional Review Act of 1996, (5 USC 801-808), 29 March 1996.
- EO-13045: Protection of Children from Environmental Health & Safety Risks, 21 April 1997.
- EO-13083: Federalism, 14 May 1998 (revoked 1987 EO-12612 & 1993 EO-12875).
- OMB Circular Nr. A-119: Use of Voluntary Consensus Standards, 10 Feb 1998.
- EO-13084: Consultation and Coordination With Indian Tribal Governments, 14 May 1998.

However, these other Congressional statutes, Executive Orders and Circulars do not contain or directly address ***economic analysis requirements*** in conjunction with the development of Federal regulatory actions. The scope of the present document is limited to economic analysis. But these regulatory development requirements may contain other types of provisions to which this RCRA listing proposal is subject for compliance (refer to the following website for additional information on the above regulatory requirements: http://www.epa.gov). Interested readers are advised to consult the listing proposal announcement in the Federal Register for information about the identity and applicability of such other regulatory analysis and procedural requirements applied by the USEPA-OSW, in conjunction with development of this listing proposal.

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ATTACHMENTS

A: CAHC Environmental Releases and Waste Constituent Quantities.

B: Summary of 1997 RCRA Section 3007 Industry Survey Findings.

C: Estimated Subtotal Industry Compliance Costs for the Sludge Waste Category of the RCRA Listing Proposal.

D: Estimated Subtotal Industry Compliance Costs for the Wastewater Category of the RCRA Listing Proposal.

E: Estimated Total Industry Compliance Costs (Sludges + Wastewaters).

F: US Chemical Industry Sales and Profit Performance Data (1992-1998).

G: Small Business Documentation for Compliance with the 1980 Regulatory Flexibility Act (as Amended by the 1996 SBREFA).

ATTACHMENT A:
Summary of CAHC Environmental Releases and CAHC Waste Constituent Quantities (1996 USEPA Toxic Release Inventory Database)

EXHIBIT A-1

USEPA TRI REFERENCE LIST OF CHLORINATED ALIPHATIC HYDROCARBON COMPOUNDS (CAHCs)
SORTED BELOW BY CAHC SUBCLASS (IF IN THE 1995 AND/OR 1996 USEPA TRI DATABASE)
(Based on CAHCs contained in the USEPA Toxic Release Inventory databases of 1995 & 1996 US industrial waste constituents in SIC codes 20-39)

Sub rank	Notations				CAHC subclass (1,2,3)	CAS number	Chemical Abstracts or IUPAC Name*	Common or Trade Name(s)
A. Chlorinated Only (subclass = 1):								
1					1	107-05-1	3-Chloro-1-propane	Allyl chloride
2	Carc				1	56-23-5	Tetrachloromethane	Carbon tetrachloride
3					1	75-00-3	Chloroethane	Ethyl chloride
4	Carc				1	67-66-3	Trichloromethane	Chloroform
5					1	74-87-3	Chloromethane	Methyl chloride
6	Carc				1	563-47-3	3-Chloro-2-methyl-1-propene	
7		+ +			1	126-99-8	2-Chloro-1,3-butadiene	Chloroprene
8		+ +			1	764-41-0	1,4-Dichloro-2-butene	Dichlorobutene
9		+ +	+ 95		1	110-57-6	trans-1,4-Dichloro-2-butene	trans-Dichlorobutene
10	Carc				1	107-06-2	1,2-Dichloroethane	Ethylene dichloride (or EDC)
11					1	540-59-0	1,2-Dichloroethylene	
12	Carc				1	75-09-2	Dichloromethane	Methylene dichloride***
13					1	78-87-5	1,2-Dichloropropane	Propylene dichloride
14	Carc		+ 95		1	10061-02-6	trans-1,3-Dichloropropene	
15					1	78-88-6	2,3-Dichloropropene	
16	Carc				1	542-75-6	1,3-Dichloropropylene	1,3-Dichloropropene (DCP or Telone II)
17					1	75-34-3	1,1-Dichloroethane	Ethylidene dichloride
18					1	87-68-3	Hexachloro-1,3-butadiene	Hexachlorobutadiene
19				-96	1	319-84-6	alpha-Hexachlorocyclohexane	
20		+ +			1	77-47-4	1,2,3,4,5,5-Hexachloro-1,3-cyclopentadiene	Hexachlorocyclopentadiene
21					1	67-72-1	Hexachloroethane	
22	Carc				1	58-89-9	1,2,3,4,5,6-Hexachlorocyclohexane	Lindane
23					1	76-01-7	Pentachloroethane	Pentalin
24			+ 95		1	—	Designation of multiple chemicals in same class	Polychlorinated alkanes
25					1	630-20-6	1,1,1,2-Tetrachloroethane	
26					1	79-34-5	1,1,2,2-Tetrachloroethane	
27	Carc				1	127-18-4	Tetrachloroethene	Tetrachloroethylene (Perchloroethylene or PERC)
28					1	71-55-6	1,1,1-Trichloroethane	Methylchloroform (MC or 1,1,1-TCE)
29					1	79-00-5	1,1,2-Trichloroethane	
30	Carc				1	79-01-6	1,1,2-Trichloroethene	Trichloroethylene or Trichloroethene (TCE)
31	Carc		+ 95		1	96-18-4	1,2,3-Trichloropropane	
32	Carc				1	75-01-4	Chloroethene	Vinyl chloride (or VCM)
33					1	75-35-4	1,1-Dichloroethene	Vinylidene chloride
B. Chlorinated Plus Other Halogens (subclass = 2):								
1					2	353-59-3	Bromochlorodifluoromethane	Halon 1211
2					2	75-68-3	1-Chloro-1,1-difluoroethane	HCFC-142b
3					2	75-45-6	Chlorodifluoromethane	HCFC-22
4				-96	2	63938-10-3	Chlorotetrafluoroethane	
5					2	354-25-6	1-Chloro-1,1,2,2-tetrafluoroethane	HCFC-124a
6					2	2837-89-0	2-Chloro-1,1,1,2-tetrafluoroethane	HCFC-124
7			+ 95		2	75-88-7	2-Chloro-1,1,1-trifluoroethane	HCFC-133a
8			+ 95		2	75-72-9	Chlorotrifluoromethane	CFC-13
9				-96	2	460-35-5	3-Chloro-1,1,1,-trifluoropropane	HCFC-253fb
10	Carc			-96	2	96-12-8	1,2-Dibromo-3-chloropropane	DBCP
11					2	75-27-4	Dichlorobromomethane	
12			+ 95		2	1649-08-7	1,2-Dichloro-1,1-difluoroethane	HCFC-132b
13					2	75-71-8	Dichlorodifluoromethane	CFC-12
14					2	1717-00-6	1,1-Dichloro-1-fluoroethane	HCFC-141b
15			+ 95		2	75-43-4	Dichlorofluoromethane	HCFC-21
16				-96	2	127564-92-5	Dichloropentafluoropropane	
17				-96	2	13474-88-9	1,1-Dichloro-1,2,2,3,3-pentafluoropropane	HCFC-225cc
18				-96	2	111512-56-2	1,1-Dichloro-1,2,3,3,3-pentafluoropropane	HCFC-225eb
19				-96	2	422-44-6	1,1-Dichloro-1,1,2,3,3-pentafluoropropane	HCFC-225bb
20				-96	2	431-86-7	1,1-Dichloro-1,1,3,3,3-pentafluoropropane	HCFC-225da
21			+ 95		2	507-55-1	1,3-Dichloro-1,1,2,2,3-pentafluoropropane	HCFC-225cb
22				-96	2	136013-79-1	1,3-Dichloro-1,1,2,3,3-pentafluoropropane	HCFC-225ea
23				-96	2	128903-21-9	1,3-Dichloro-1,1,1,3,3-pentafluoropropane	HCFC-225aa
24				-96	2	422-48-0	1,3-Dichloro-1,1,1,2,3-pentafluoropropane	HCFC-225ba
25			+ 95		2	422-56-0	3,3-Dichloro-1,1,1,2,2-pentafluoropropane	HCFC-225ca
26					2	76-14-2	Dichlorotetrafluoroethane	CFC-114
27					2	34077-87-7	Dichlorotrifluoroethane	
28				-96	2	90454-18-5	Dichloro-1,1,2-trifluoroethane	
29				-96	2	812-04-4	1,1-Dichloro-1,2,2-trifluoroethane	HCFC-123b
30					2	354-23-4	1,2-Dichloro-1,1,2-trifluoroethane	HCFC-123a
31					2	306-83-2	2,2-Dichloro-1,1,1-trifluoroethane	HCFC-123
32					2	76-13-1	1,1,2-Trichlorotrifluoroethane	Freon 113
33					2	76-15-3	Monochloropentafluoroethane	CFC-115
34				-96	2	354-11-0	1,1,1,2-Tetrachloro-1-fluoroethane	HCFC-121a
35			+ 95	-96	2	354-14-3	1,1,2,2-Tetrachloro-1-fluoroethane	HCFC-121
36					2	75-69-4	Trichlorofluoromethane	CFC-11
C. Chlorinated Plus Other Chemical Elements (Functional Groups) (subclass = 3):								
1					3	111-91-1	Bis(2-chloroethoxy) methane	
2					3	111-44-4	Bis(2-chloroethyl) ether	
3	Carc				3	542-88-1	Bis(chloromethyl) ether	
4					3	108-60-1	Bis(2-chloro-1-methylethyl) ether	
5					3	79-11-8	Chloroacetic acid	
6	Carc				3	107-30-2	Chloromethyl methyl ether	
7			+ 95		3	76-06-2	Trichloronitromethane	Chloropicrin
8				-96	3	542-76-7	3-Chloropropionitrile	
9	Carc			-96	3	79-44-7	Dimethylcarbamyl chloride	
10					3	2524-03-0	Dimethyl chlorothiophosphate	
11					3	541-41-3	Ethyl chloroformate	
12					3	79-22-1	Methyl chlorocarbonate	
13	Carc				3	505-60-2	1,1'-thiobis[2-chloro-] ethane	Mustard gas
14	Carc			-96	3	51-75-2	2-Chloro-N-(2-chloroethyl)-N-methylethanamine	Nitrogen mustard
15					3	52-68-6	2,2,2-trichloro-1-hydroxyethyl)-dimethyl ester phosphonic acid	Trichlorfon
16					3	76-02-8	Trichloroacetyl chloride	

Explanatory Notes:
(a) CAHC subclasses: 1 = chlorinated only; 2 = chlorinated + other halogens; 3 = chlorinated + other chemical elements (functional groups).
(b) "Carc" denotes chemicals designated as known or suspected carcinogens by the OSHA (29 CFR 1910.1200), based on IARC, NTP and OSHA criteria.
(c) " + /-95" & " + /-96" denote chemicals added to or subtracted from the TRI database by the USEPA in survey reporting years 1995 & 1996.
(d) + + Denotes chemicals used as captive intermediates in synthesis of other compounds, for which production volumes usually not published (USEPA 1984, p.8).
(e) * The CAS and IUPAC name may be identical (e.g. dichloromethane); however when different, In most instances there are minor variations between the CAS and IUPAC naming systems (e.g. 1,3-Dichloro-1-propene (CAS), compared to 1,3-Dichloropropene (IUPAC)).
(f) ** TRI = Toxic Release Inventory survey database maintained by the USEPA on manufacturers, processors, and users of 579 TRI-listed toxic chemicals. Facilities in SIC codes 20-39 with > 9 employees, which manufacture/process > 25,000 lbs or use > 10,000 lbs per year, must report to the TRI survey.
(g) *** Some chemicals may have more than one common and trade name (e.g. for the CAS/IUPAC name dichloromethane, there are at least four common name synonyms (methane dichloride, methylene

bichloride, methylene chloride, and methylene dichloride), and at least five trade names (Aerothene MM, Narkotil, R30, Solaesthin, and Solmethine)); source WHO, 1986, p.43.
(h) CFC = chlorofluorocarbon; HCFC = hydrochlorofluorocarbon (generic designations of chemical classes).

EXHIBIT A-2

PROFILE OF CAHCs IN WASTES PRODUCED BY INDUSTRIAL MANUFACTURERS, PROCESSERS & OTHER USERS
OF TRI-LISTED TOXIC CHEMICALS IN SIC CODES 20-39: QUANTITY OF CAHC CONSTITUENTS IN WASTES BY ON-SITE AND OFF-SITE WASTE MANAGEMENT
NOTE: CHEMICALS SORTED BELOW ACCORDING TO DESCENDING ORDER BY WASTE QUANTITY (Source: USEPA 1996 Toxic Release Inventory (TRI) Public Data Release Report Nr. 745-R-98-005: http://www.epa.gov/opptintr/tri/pdr96/drhome.htm).

				A	B	C	D	E	F	G	H	I	J	K	L	M	N
							(A + B + C)						(E + ... + I)		(D + J + K)		
				ON-SITE MANAGEMENT				OFF-SITE MANAGEMENT									
	CAHC sub-class (1,2,3)	CAS** Number	Chemical name	Recycled onsite (tons)	Energy recovery onsite (tons)	Treatment onsite (tons)	Total management onsite (tons)	Transfers to recycling (tons)	Transfers to energy recovery (tons)	Transfers to treatment (tons)	Transfers to POTWs (tons)	Transfers to others (tons)	Total transfers (tons)	RELEASES onsite + offsite (tons)	Total quantity constituent in production related waste (tons)	Row percent	Cumltv percent
A. Chlorinated Only (subclass = 1):																	
Carc	1	75-09-2	Dichloromethane	56,032.5	2,799.5	11,603.8	70,435.7	5,900.0	1,502.8	5,951.8	320.1	907.9	14,582.7	27,150.7	111,845.5	13.66%	13.7%
Carc	1	75-01-4	Vinyl chloride	72,128.5	17,451.1	17,274.6	106,854.2	54.2	8.5	28.7	0.4	0.0	91.8	520.1	107,464.1	13.12%	26.8%
Carc	1	107-06-2	1,2-Dichloroethane	23,909.2	24,524.3	24,245.6	72,679.1	8,478.6	542.6	463.1	3.2	0.0	9,487.4	584.0	82,734.5	10.10%	36.9%
Carc	1	79-01-6	Trichloroethylene	59,260.3	1,025.4	2,679.1	62,964.8	3,334.9	380.8	803.1	43.2	0.0	4,561.9	10,686.7	78,451.2	9.58%	46.5%
Carc	1	127-18-4	Tetrachloroethylene	23,355.4	1,323.9	10,337.4	35,016.7	2,911.2	265.3	720.0	0.9	0.0	3,897.5	3,964.2	42,985.0	5.25%	51.7%
	1	79-00-5	1,1,2-Trichloroethane	11,764.5	8,417.3	10,194.1	30,375.9	6,543.5	152.7	1,411.5	0.4	0.0	8,108.0	169.8	38,642.0	4.72%	56.4%
	1	78-87-5	1,2-Dichloropropane	18,606.5	11,280.0	2,558.7	32,445.2	0.0	0.0	0.1	0.8	0.0	0.8	260.9	32,706.7	3.99%	60.4%
	1	71-55-6	1,1,1-Trichloroethane	19,764.6	430.4	592.3	20,787.3	720.8	169.4	511.7	5.2	0.0	1,407.0	4,415.0	26,462.5	3.23%	63.6%
	1	75-00-3	Chloroethane	1,954.9	6,122.1	14,494.3	22,571.3	77.9	19.9	245.4	0.4	1.0	344.5	1,276.8	24,192.1	2.95%	66.6%
Carc	1	56-23-5	Carbon tetrachloride	1,036.8	525.0	20,908.3	22,470.1	64.4	13.2	800.4	0.2	0.0	878.2	202.4	22,995.6	2.81%	69.4%
Carc	1	67-66-3	Chloroform	3,019.6	4,443.6	6,726.7	14,189.8	334.4	94.7	930.2	164.8	0.0	1,524.1	4,889.4	20,828.0	2.54%	72.0%
	1	74-87-3	Chloromethane	1,499.6	2,246.5	6,495.8	10,241.9	0.0	3.1	126.5	4.9	0.0	134.5	2,279.4	12,740.2	1.56%	73.5%
	1	79-34-5	1,1,2,2-Tetrachloroethane	2,404.0	462.0	5,512.1	8,378.1	1,190.1	0.0	124.0	0.0	0.0	1,314.2	7.8	9,700.1	1.18%	74.7%
Carc	1	542-75-6	1,3-Dichloropropylene	1,518.4	7,000.0	286.6	8,805.0	0.0	2.4	26.9	0.0	0.0	29.3	5.4	8,839.4	1.08%	75.8%
Carc	1	96-18-4	1,2,3-Trichloropropane	3,050.0	345.0	525.0	3,920.0	0.0	0.0	4,500.0	0.0	0.0	4,500.0	4.4	8,424.3	1.03%	76.8%
Carc	1	10061-02-6	trans-1,3-Dichloropropene	24.5	6,000.0	0.0	6,024.5	0.0	0.0	0.1	0.0	0.0	0.1	0.4	6,025.1	0.74%	77.5%
	1	76-01-7	Pentachloroethane	2,075.0	195.0	3,265.9	5,535.9	0.0	6.2	104.0	0.0	0.0	110.2	0.8	5,646.9	0.69%	78.2%
	1	126-99-8	Chloroprene	0.0	472.2	3,625.1	4,097.3	140.8	7.0	126.4	8.1	0.0	282.3	581.7	4,956.2	0.61%	78.8%
	1	75-35-4	Vinylidene chloride	770.0	40.5	2,972.2	3,782.7	0.0	22.6	18.1	0.0	0.0	40.7	88.7	3,959.8	0.48%	79.3%
	1	78-88-6	2,3-Dichloropropene	1,900.0	1,300.0	242.0	3,442.0	0.0	0.0	180.0	0.0	0.0	180.0	10.5	3,632.7	0.44%	79.8%
	1	87-68-3	Hexachloro-1,3-butadiene	0.0	33.0	3,053.7	3,086.7	0.0	0.0	138.8	0.0	0.0	138.8	1.9	3,227.9	0.39%	80.2%
	1	67-72-1	Hexachloroethane	0.0	469.5	2,300.4	2,769.9	0.0	35.5	60.5	0.0	0.0	96.0	2.7	2,868.1	0.35%	80.5%
	1	630-20-6	1,1,1,2-Tetrachloroethane	1,250.0	0.0	1,418.5	2,668.5	0.0	70.0	118.9	0.0	0.0	188.9	3.3	2,860.8	0.35%	80.9%
	1	764-41-0	1,4-Dichloro-2-butene	900.0	0.0	1,500.0	2,400.0	0.0	0.0	160.0	0.0	0.0	160.0	3.3	2,563.3	0.31%	81.2%
	1	540-59-0	1,2-Dichloroethylene	310.0	780.0	914.1	2,004.1	1.6	0.0	4.4	0.0	0.0	5.9	4.1	2,025.9	0.25%	81.4%
	1	75-34-3	Ethylidene dichloride	650.0	70.4	1,205.1	1,925.5	0.0	0.0	9.3	0.0	0.0	9.3	11.0	1,945.8	0.24%	81.6%
	1	107-05-1	Allyl chloride	130.0	1,150.0	252.2	1,532.2	0.0	0.2	243.7	0.0	0.0	243.9	40.1	1,820.5	0.22%	81.9%
	1	—	Polychlorinated alkanes	8.6	34.5	114.1	157.2	135.7	115.1	143.6	37.4	0.0	431.8	50.5	658.1	0.08%	82.0%
Carc	1	563-47-3	3-Chloro-2-methyl-1-propene	0.0	0.0	172.6	172.6	0.0	0.0	26.1	0.1	0.0	26.2	11.5	210.3	0.03%	82.0%
	1	77-47-4	Hexachlorocyclopentadiene	0.0	0.0	123.2	123.2	0.0	0.4	27.5	0.8	0.0	28.7	4.6	156.5	0.02%	82.0%
Carc	1	58-89-9	1,2,3,4,5,6-Hexachlorocyclohexane (Lindane)	0.2	0.0	0.0	0.2	0.0	0.0	0.7	0.0	0.0	0.7	0.5	1.0	0.00%	82.0%
	1	110-57-6	trans-1,4-Dichloro-2-butene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.00%	82.0%
			Subclass 1 column subtotals =	307,323.0	98,941.0	155,593.7	561,857.7	29,887.9	3,412.1	18,005.5	590.8	908.9	52,805.2	57,232.7	671,570.0	82.0%	
			Column subtotal percentages =	45.8%	14.7%	23.2%	83.7%	4.5%	0.5%	2.7%	0.1%	0.1%	7.9%	8.5%	100.0%		
B. Chlorinated Plus Other Halogens (subclass = 2):																	
	2	76-13-1	Freon-113 (1,1,2-trichlorotrifluoroethane)	346.4	37.1	109,529.7	109,913.1	57.4	26.8	537.2	0.1	0.0	621.6	702.1	111,266.8	13.59%	95.6%
	2	75-45-6	Chlorodifluoromethane (HCFC-22)	2,323.5	0.0	278.4	2,601.9	116.4	0.4	137.9	0.0	0.0	254.6	4,916.7	7,700.8	0.94%	96.5%
	2	1717-00-6	1,1-Dichloro-1-fluoroethane (HCFC-141b)	194.9	0.0	1,034.9	1,229.8	116.3	139.9	550.8	1.5	0.0	808.4	4,701.2	6,750.5	0.82%	97.3%
	2	75-68-3	1-Chloro-1,1-difluoroethane (HCFC-142b)	6.6	0.0	77.4	84.0	7.0	0.0	21.4	0.0	0.0	28.4	3,124.6	3,247.8	0.40%	97.7%
	2	76-14-2	Dichlorotetrafluoroethane (CFC-114)	50.4	0.0	815.7	866.1	100.3	0.0	8.1	0.0	0.0	108.4	425.7	1,404.1	0.17%	97.9%
	2	75-71-8	Dichlorodifluoromethane (CFC-12)	270.3	0.0	8.5	278.8	211.5	0.0	21.8	0.0	0.0	233.4	665.4	1,070.5	0.13%	98.0%
	2	2837-89-0	2-Chloro-1,1,1,2-tetrafluoro-ethane (HCFC-124)	92.4	0.0	91.5	184.0	113.3	0.0	0.0	0.0	0.0	113.3	452.7	769.6	0.09%	98.1%
	2	75-69-4	Trichlorofluoromethane (CFC-11)	84.1	0.0	2.5	86.6	62.5	92.4	50.4	0.0	39.3	244.6	349.7	667.8	0.08%	98.2%
	2	34077-87-7	Dichlorotrifluoroethane	0.0	0.0	358.2	358.2	0.0	0.0	0.0	0.0	0.0	0.0	0.5	358.7	0.04%	98.3%
	2	353-59-3	Bromochlorodifluoromethane (Halon-1211)	337.3	0.0	0.0	337.3	0.0	0.0	0.0	0.0	0.0	0.0	2.3	339.7	0.04%	98.3%
	2	354-25-6	1-Chloro-1,1,2,2-tetra-fluoroethane (HCFC-124a)	0.0	0.0	16.6	16.6	0.0	0.0	0.0	0.0	0.0	0.0	298.3	314.6	0.04%	98.3%
	2	306-83-2	2,2-Dichloro-1,1,1-trifluoro-ethane (HCFC-123)	126.5	0.0	2.5	129.0	0.0	0.0	3.0	0.0	0.0	3.0	114.7	236.6	0.03%	98.4%
	2	76-15-3	Monochloropentafluoroethane (CFC-115)	55.0	0.0	34.3	89.3	0.0	0.0	7.1	0.0	0.0	7.1	36.4	132.9	0.02%	98.4%
	2	75-43-4	Dichlorofluoromethane (HCFC-21)	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	78.0	76.4	0.01%	98.4%
	2	1649-08-7	1,2-Dichloro-1,1-difluoro-ethane (HCFC-132b)	0.0	0.0	48.0	48.0	0.0	0.0	18.5	0.0	0.0	18.5	0.5	67.0	0.01%	98.4%
	2	354-23-4	1,2-Dichloro-1,1,2-trifluoro-ethane (HCFC-123a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.6	34.8	0.00%	98.4%
	2	75-88-7	2-Chloro-1,1,1-trifluoroethane (HCFC-133a)	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.0	0.0	8.3	17.1	25.4	0.00%	98.4%
	2	507-55-1	1,3-Dichloro-1,1,2,2,3-penta-fluoropropane (HCFC-225cb)	2.4	0.0	0.0	2.4	1.2	0.0	0.7	0.0	0.0	1.9	14.5	18.8	0.00%	98.4%
	2	422-56-0	3,3-Dichloro-1,1,1,2,2-penta-fluoropropane (HCFC-225ca)	2.0	0.0	0.0	2.0	1.0	0.0	0.6	0.0	0.0	1.5	12.0	15.5	0.00%	98.4%
	2	75-72-9	Chlorotrifluoromethane (CFC-13)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	4.8	0.00%	98.4%
	2	75-27-4	Dichlorobromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3	0.00%	98.4%
			Subclass 2 column subtotals =	3,891.9	37.1	112,298.2	116,227.1	786.9	259.5	1,365.7	1.6	39.3	2,453.0	15,953.1	134,504.3	16.4%	
			Column subtotal percentages =	2.9%	0.0%	83.5%	86.4%	0.6%	0.2%	1.0%	0.0%	0.0%	1.8%	11.9%	100.0%		
C. Chlorinated Plus Other Chemical Elements (Functional Groups) (subclass = 3):																	
	3	108-60-1	Bis(2-chloro-1-methylethyl) ether	6,500.0	0.0	4,467.0	10,967.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	10,969.4	1.34%	99.8%
	3	111-44-4	Bis(2-chloroethyl) ether	0.0	286.5	480.2	766.7	90.0	203.8	17.3	1.2	0.0	312.3	1.5	1,080.4	0.13%	99.9%
	3	79-11-8	Chloroacetic acid	21.2	0.0	818.5	839.7	0.0	0.0	0.1	0.6	0.0	0.8	3.5	843.1	0.10%	100.0%
	3	76-06-2	Chloropicrin	15.0	0.0	0.2	15.1	0.0	0.0	0.2	0.0	0.0	0.2	6.0	21.3	0.00%	100.0%
	3	541-41-3	Ethyl chloroformate	0.0	0.0	5.8	5.8	0.0	0.0	0.0	0.0	0.0	0.0	2.4	8.1	0.00%	100.0%
Carc	3	107-30-2	Chloromethyl methyl ether	0.0	0.0	4.1	4.1	0.0	0.0	0.0	0.0	0.0	0.0	1.5	5.6	0.00%	100.0%
	3	111-91-1	Bis(2-chloroethoxy) methane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	4.3	0.00%	100.0%
	3	79-22-1	Methyl chlorocarbonate	0.0	0.0	2.1	2.1	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.3	0.00%	100.0%
Carc	3	542-88-1	Bis(chloromethyl) ether	0.0	0.0	3.3	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.00%	100.0%
	3	2524-03-0	Dimethyl chlorothiophosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00%	100.0%
	3	76-02-8	Trichloroacetyl chloride	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00%	100.0%
Carc	3	505-60-2	Mustard gas (1,1'-thiobis[2-chloro-] ethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00%	100.0%
	3	52-68-6	Trichlorfon (2,2,2-trichloro-1-hydroxyethyl)-dimethyl ester phosphonic acid)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00%	100.0%
			Subclass 3 column subtotals =	6,536.2	286.5	5,781.0	12,603.7	90.0	203.8	17.7	1.8	0.0	313.3	22.6	12,938.7	1.6%	
			Column subtotal percentages =	50.5%	2.2%	44.7%	97.4%	0.7%	1.6%	0.1%	0.0%	0.0%	2.4%	0.2%	100.0%		
			Column totals (all subclasses) =	317,751	99,265	273,673	690,688	30,765	3,875	19,389	594	948	55,572	73,208	819,013	100%	
			Column percentages =	38.8%	12.1%	33.4%	84.3%	3.8%	0.5%	2.4%	0.1%	0.1%	6.8%	8.9%	100%		

Explanatory Notes:
(a) *USEPA's TRI contains survey data from facilities in SIC codes 20-39 with >9 full-time employees and which manufacture/process 25,000 lbs or use 10,000 lbs of TRI-listed chemicals in a year.
(b) **Cas number = Chemical Abstracts Service registry number assigned by the American Chemical Society for identification and inventory of the universe of known chemicals.
(c) "Carc" denotes chemicals designtaed as know or suspected carcinogens by the OSHA (29 CFR 1910.1200), based on IARC, NTP and OSHA criteria.

EXHIBIT A-3

FACILITY ON-SITE ENVIRONMENTAL RELEASES (1996 TONS): DATA EXTRACTION FRROM THE 1996 USEPA TRI PUBLIC REPORT

	CAHC sub-class (1,2,3)	CAS Number	Chemical Name	A Fugitive or nonpoint Air emissions (tons)	B Stack or point Air emissions (tons)	C Surface water discharges (tons)	D Underground Injection Class I	E Underground Injection	F RCRA Subtitle C landfills (tons)	G Other onsite land releases* (tons)	H (A+...+G) Total onsite releases (tons)	I Transfers offsite to disposal (tons)	J (H+I) On- and offsite releases (tons)	K Row percent	L Cumlty. percent
A. Chlorinated Only (Subclass = 1):															
Carc	1	75-09-2	Dichloromethane	10,760.0	15,950.3	5.0	374.8	0.0	0.0	2.5	27,092.5	58.2	**27,150.7**	37.09%	37.1%
Carc	1	79-01-6	Trichloroethylene	5,332.7	5,303.4	0.3	0.6	0.0	2.8	8.8	10,648.6	38.2	**10,686.7**	14.60%	51.7%
Carc	1	67-66-3	Chloroform	1,543.2	3,117.6	170.2	22.7	0.0	12.6	3.8	4,870.0	19.4	**4,889.4**	6.68%	58.4%
	1	71-55-6	1,1,1-Trichloroethane	2,169.7	2,214.1	0.4	0.7	0.0	2.3	10.9	4,398.0	17.0	**4,415.0**	6.03%	64.4%
Carc	1	127-18-4	Tetrachloroethylene	1,547.8	2,382.8	0.7	6.7	0.0	13.0	2.2	3,953.2	11.0	**3,964.2**	5.41%	69.8%
	1	74-87-3	Chloromethane	386.2	1,842.7	0.4	49.9	0.0	0.0	0.0	2,279.2	0.2	**2,279.4**	3.11%	72.9%
	1	75-00-3	Chloroethane	565.3	711.3	0.1	0.0	0.0	0.0	0.0	1,276.8	0.0	**1,276.8**	1.74%	74.7%
Carc	1	107-06-2	1,2-Dichloroethane	217.0	305.3	0.9	2.6	0.0	12.5	0.1	538.4	45.6	**584.0**	0.80%	75.5%
	1	126-99-8	Chloroprene	56.5	456.6	0.0	60.0	0.0	4.3	0.0	577.4	4.3	**581.7**	0.79%	76.3%
Carc	1	75-01-4	Vinyl chloride	136.5	373.4	0.2	0.2	0.0	0.0	0.0	510.2	9.8	**520.1**	0.71%	77.0%
	1	78-87-5	1,2-Dichloropropane	112.2	145.0	0.9	0.0	0.0	0.0	0.1	258.2	2.7	**260.9**	0.36%	77.3%
Carc	1	56-23-5	Carbon tetrachloride	70.3	105.2	0.1	22.3	0.0	0.0	0.0	197.8	4.6	**202.4**	0.28%	77.6%
	1	79-00-5	1,1,2-Trichloroethane	16.6	153.0	0.3	0.0	0.0	0.0	0.0	169.8	0.0	**169.8**	0.23%	77.8%
	1	75-35-4	Vinylidene chloride	41.3	47.3	0.1	0.0	0.0	0.0	0.0	88.7	0.0	**88.7**	0.12%	78.0%
	1	—	Polychlorinated alkanes	0.9	0.5	4.2	0.0	0.0	0.0	0.3	5.9	44.6	**50.5**	0.07%	78.0%
	1	107-05-1	Allyl chloride	28.0	12.1	0.0	0.0	0.0	0.0	0.0	40.1	0.0	**40.1**	0.05%	78.1%
Carc	1	563-47-3	3-Chloro-2-methyl-1-propene	0.2	11.3	0.0	0.0	0.0	0.0	0.0	11.5	0.0	**11.5**	0.02%	78.1%
	1	75-34-3	Ethylidene dichloride	3.9	7.1	0.0	0.0	0.0	0.0	0.0	11.0	0.0	**11.0**	0.01%	78.1%
	1	78-88-6	2,3-Dichloropropene	0.3	0.3	10.0	0.0	0.0	0.0	0.0	10.5	0.0	**10.5**	0.01%	78.1%
	1	79-34-5	1,1,2,2-Tetrachloroethane	6.3	1.4	0.1	0.0	0.0	0.0	0.0	7.8	0.0	**7.8**	0.01%	78.1%
Carc	1	542-75-6	1,3-Dichloropropylene	4.3	0.4	0.6	0.0	0.0	0.0	0.0	5.4	0.0	**5.4**	0.01%	78.1%
	1	77-47-4	Hexachlorocyclopentadiene	3.7	0.3	0.0	0.1	0.0	0.0	0.0	4.1	0.5	**4.6**	0.01%	78.1%
Carc	1	96-18-4	1,2,3-Trichloropropane	4.0	0.3	0.0	0.0	0.0	0.0	0.0	4.4	0.0	**4.4**	0.01%	78.2%
	1	540-59-0	1,2-Dichloroethylene	1.5	2.6	0.0	0.0	0.0	0.0	0.0	4.1	0.0	**4.1**	0.01%	78.2%
	1	630-20-6	1,1,1,2-Tetrachloroethane	2.0	1.3	0.0	0.0	0.0	0.0	0.0	3.2	0.0	**3.3**	0.00%	78.2%
	1	764-41-0	1,4-Dichloro-2-butene	0.0	1.5	0.0	1.7	0.0	0.0	0.0	3.3	0.0	**3.3**	0.00%	78.2%
	1	67-72-1	Hexachloroethane	1.1	0.4	0.0	1.0	0.0	0.0	0.0	2.5	0.2	**2.7**	0.00%	78.2%
	1	87-68-3	Hexachloro-1,3-butadiene	0.7	0.5	0.1	0.5	0.0	0.0	0.0	1.8	0.2	**1.9**	0.00%	78.2%
	1	76-01-7	Pentachloroethane	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.8	0.0	**0.8**	0.00%	78.2%
	1	58-89-9	1,2,3,4,5,6-Hexachlorocyclohexane (Lindane)	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.4	0.1	**0.5**	0.00%	78.2%
Carc	1	10061-02-6	trans-1,3-Dichloropropene	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	**0.4**	0.00%	78.2%
	1	110-57-6	trans-1,4-Dichloro-2-butene	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	**0.1**	0.00%	78.2%
			Subclass 1 column subtotals =	23,013.3	33,148.0	194.7	543.7	0.0	47.4	28.9	56,975.9	256.8	**57,232.7**	**78.2%**	
			Column subtotal percentages =	40.2%	57.9%	0.3%	0.9%	0.0%	0.1%	0.1%	99.6%	0.4%	100.0%		
B. Chlorinated Plus Other Halogens (Subclass = 2):															
	2	75-45-6	Chlorodifluoromethane (HCFC-22)	2,194.0	2,694.3	1.3	0.0	0.0	0.0	0.0	4,889.6	27.1	**4,916.7**	6.72%	84.9%
	2	1717-00-6	1,1-Dichloro-1-fluoroethane (HCFC-141b)	2,668.5	1,920.6	0.3	0.0	0.0	0.0	2.9	4,592.3	108.9	**4,701.2**	6.42%	91.3%
	2	75-68-3	1-Chloro-1,1-difluoroethane (HCFC-142b)	338.6	2,783.3	1.4	0.0	0.0	0.0	0.0	3,123.4	1.2	**3,124.6**	4.27%	95.6%
	2	76-13-1	Freon-113 (1,1,2-trichlorotrifluoroethane)	496.2	204.9	0.4	0.0	0.0	0.0	0.0	701.5	0.6	**702.1**	0.96%	96.5%
	2	75-71-8	Dichlorodifluoromethane (CFC-12)	547.7	114.5	0.0	0.0	0.0	0.0	3.0	665.2	0.2	**665.4**	0.91%	97.5%
	2	2837-89-0	2-Chloro-1,1,1,2-tetrafluoro-ethane (HCFC-124)	119.4	332.9	0.5	0.0	0.0	0.0	0.0	452.7	0.0	**452.7**	0.62%	98.1%
	2	76-14-2	Dichlorotetrafluoroethane (CFC-114)	349.8	73.5	2.5	0.0	0.0	0.0	0.0	425.7	0.0	**425.7**	0.58%	98.7%
	2	75-69-4	Trichlorofluoromethane (CFC-11)	276.2	70.2	0.5	0.0	0.0	0.0	2.8	349.6	0.1	**349.7**	0.48%	99.1%
	2	354-25-6	1-Chloro-1,1,2,2-tetra-fluoroethane (HCFC-124a)	2.3	295.9	0.0	0.0	0.0	0.0	0.0	298.3	0.0	**298.3**	0.41%	99.5%
	2	306-83-2	2,2-Dichloro-1,1,1-trifluoro-ethane (HCFC-123)	96.8	17.8	0.1	0.0	0.0	0.0	0.0	114.7	0.0	**114.7**	0.16%	99.7%
	2	75-43-4	Dichlorofluoromethane (HCFC-21)	7.4	65.3	0.0	0.0	0.0	0.0	0.0	72.6	5.3	**78.0**	0.11%	99.8%
	2	76-15-3	Monochloropentafluoroethane (CFC-115)	33.8	1.6	1.1	0.0	0.0	0.0	0.0	36.4	0.0	**36.4**	0.05%	99.8%
	2	354-23-4	1,2-Dichloro-1,1,2-trifluoro-ethane (HCFC-123a)	33.2	1.3	0.1	0.0	0.0	0.0	0.0	34.6	0.0	**34.6**	0.05%	99.9%
	2	75-88-7	2-Chloro-1,1,1-trifluoroethane (HCFC-133a)	0.1	17.0	0.0	0.0	0.0	0.0	0.0	17.1	0.0	**17.1**	0.02%	99.9%
	2	507-55-1	1,3-Dichloro-1,1,2,2,3-penta-fluoropropane (HCFC-225cb)	14.5	0.0	0.0	0.0	0.0	0.0	0.0	14.5	0.0	**14.5**	0.02%	99.9%
	2	422-56-0	3,3-Dichloro-1,1,1,2,2-penta-fluoropropane (HCFC-225ca)	12.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.0	**12.0**	0.02%	100.0%
	2	75-72-9	Chlorotrifluoromethane (CFC-13)	0.9	3.8	0.1	0.0	0.0	0.0	0.0	4.8	0.0	**4.8**	0.01%	100.0%
	2	353-59-3	Bromochlorodifluoromethane (Halon-1211)	2.3	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	**2.3**	0.00%	100.0%
	2	75-27-4	Dichlorobromomethane	0.0	1.2	0.0	0.0	0.0	0.0	0.1	1.3	0.0	**1.3**	0.00%	100.0%
	2	1649-08-7	1,2-Dichloro-1,1-difluoro-ethane (HCFC-132b)	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.5	0.0	**0.5**	0.00%	100.0%
	2	34077-87-7	Dichlorotrifluoroethane	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.5	0.0	**0.5**	0.00%	100.0%
			Subclass 2 column subtotals =	7,194.5	8,597.9	8.3	0.0	0.0	0.0	8.8	15,809.6	143.6	**15,953.1**	**21.8%**	
			Column subtotal percentages =	45.1%	53.9%	0.1%	0.0%	0.0%	0.0%	0.1%	99.1%	0.9%	100.0%		
C. Chlorinated Plus Other Chemical Elements (Functional Groups) (Subclass = 3):															
	3	76-06-2	Chloropicrin	2.6	3.3	0.0	0.0	0.0	0.0	0.0	5.9	0.1	**6.0**	0.01%	100.0%
	3	111-91-1	Bis(2-chloroethoxy) methane	0.7	0.0	0.0	3.3	0.0	0.3	0.0	4.3	0.0	**4.3**	0.01%	100.0%
	3	79-11-8	Chloroacetic acid	2.8	0.4	0.0	0.0	0.0	0.0	0.1	3.3	0.1	**3.5**	0.00%	100.0%
	3	541-41-3	Ethyl chloroformate	2.1	0.2	0.0	0.0	0.0	0.0	0.0	2.4	0.0	**2.4**	0.00%	100.0%
	3	108-60-1	Bis(2-chloro-1-methylethyl) ether	0.3	2.1	0.0	0.0	0.0	0.0	0.0	2.3	0.0	**2.3**	0.00%	100.0%
	3	111-44-4	Bis(2-chloroethyl) ether	0.4	1.1	0.0	0.0	0.0	0.0	0.0	1.5	0.0	**1.5**	0.00%	100.0%
Carc	3	107-30-2	Chloromethyl methyl ether	0.1	1.3	0.0	0.0	0.0	0.0	0.0	1.4	0.0	**1.5**	0.00%	100.0%
Carc	3	79-22-1	Methyl chlorocarbonate	1.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	**1.2**	0.00%	100.0%
	3	2524-03-0	Dimethyl chlorothiophosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.00%	100.0%
	3	76-02-8	Trichloroacetyl chloride	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.00%	100.0%
Carc	3	505-60-2	Mustard gas (1,1'-thiobis[2-chloro-] ethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.00%	100.0%
	3	52-68-6	Trichlorfon (2,2,2-trichloro-1-hydroxyethyl)-dimethyl ester phosphonic acid)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.00%	100.0%
Carc	3	542-88-1	Bis(chloromethyl) ether	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.00%	100.0%
			Subclass 3 column subtotals =	10.2	8.4	0.0	3.3	0.0	0.3	0.1	22.3	0.3	**22.6**	**0.03%**	
			Column subtotal percentages =	45.1%	37.0%	0.2%	14.8%	0.0%	1.2%	0.6%	98.8%	1.2%	100.0%		
			Column totals (all subclasses) =	**30,218**	**41,754**	**203**	**547**	**0**	**48**	**38**	**72,808**	**401**	**73,208**	**100%**	
			Column percents =	**41.3%**	**57.0%**	**0.3%**	**0.7%**	**0.0%**	**0.1%**	**0.1%**	**99.5%**	**0.5%**	**100%**		

Explanatory Notes: (a) *Other onsite land releases include: (a) non-RCRA landfills; (2) land treatment; (3) surface impoundment; and/or (4) spills/leadks; (b) "Carc" = chemicals designated as known or suspected carcinogens by the OSHA (29 CFR 1910.1200), based on IARC, NTP and OSHA criteria.

EXHIBIT A-4

SUMMARY OF CAHC WASTE CONSTITUENT QUANTITIES AND RELEASES FROM INDUSTRIAL PRODUCTION IN SIC CODES 20-39
(Source: 1996 USEPA Toxic Release Inventory Database)

	CAHC sub-class (1,2,3)	CAS** Number	Chemical name	A Waste constituent management onsite (tons)	B Waste constituent transfers to offsite management (tons)	C Chemical releases onsite + offsite (tons)	D (A+B+C) Total quantity constituent in production related wastes (tons)	E Row percent	F Cumltv percent
A. Chlorinated Only (subclass = 1):									
Carc	1	75-09-2	Dichloromethane	70,435.7	14,582.7	27,150.7	**111,845.5**	13.66%	13.7%
Carc	1	75-01-4	Vinyl chloride	106,854.2	91.8	520.1	**107,464.1**	13.12%	26.8%
Carc	1	107-06-2	1,2-Dichloroethane	72,679.1	9,487.4	584.0	**82,734.5**	10.10%	36.9%
Carc	1	79-01-6	Trichloroethylene	62,964.8	4,561.9	10,686.7	**78,451.2**	9.58%	46.5%
Carc	1	127-18-4	Tetrachloroethylene	35,016.7	3,897.5	3,964.2	**42,985.0**	5.25%	51.7%
	1	79-00-5	1,1,2-Trichloroethane	30,375.9	8,108.0	169.8	**38,642.0**	4.72%	56.4%
	1	78-87-5	1,2-Dichloropropane	32,445.2	0.8	260.9	**32,706.7**	3.99%	60.4%
	1	71-55-6	1,1,1-Trichloroethane	20,787.3	1,407.0	4,415.0	**26,462.5**	3.23%	63.6%
	1	75-00-3	Chloroethane	22,571.3	344.5	1,276.8	**24,192.1**	2.95%	66.6%
Carc	1	56-23-5	Carbon tetrachloride	22,470.1	878.2	202.4	**22,995.6**	2.81%	69.4%
Carc	1	67-66-3	Chloroform	14,189.8	1,524.1	4,889.4	**20,828.0**	2.54%	72.0%
	1	74-87-3	Chloromethane	10,241.9	134.5	2,279.4	**12,740.2**	1.56%	73.5%
	1	79-34-5	1,1,2,2-Tetrachloroethane	8,378.1	1,314.2	7.8	**9,700.1**	1.18%	74.7%
Carc	1	542-75-6	1,3-Dichloropropylene	8,805.0	29.3	5.4	**8,839.4**	1.08%	75.8%
Carc	1	96-18-4	1,2,3-Trichloropropane	3,920.0	4,500.0	4.4	**8,424.3**	1.03%	76.8%
Carc	1	10061-02-6	trans-1,3-Dichloropropene	6,024.5	0.1	0.4	**6,025.1**	0.74%	77.5%
	1	76-01-7	Pentachloroethane	5,535.9	110.2	0.8	**5,646.9**	0.69%	78.2%
	1	126-99-8	Chloroprene	4,097.3	282.3	581.7	**4,956.2**	0.61%	78.8%
	1	75-35-4	Vinylidene chloride	3,782.7	40.7	88.7	**3,959.8**	0.48%	79.3%
	1	78-88-6	2,3-Dichloropropene	3,442.0	180.0	10.5	**3,632.7**	0.44%	79.8%
	1	87-68-3	Hexachloro-1,3-butadiene	3,086.7	138.8	1.9	**3,227.9**	0.39%	80.2%
	1	67-72-1	Hexachloroethane	2,769.9	96.0	2.7	**2,868.1**	0.35%	80.5%
	1	630-20-6	1,1,1,2-Tetrachloroethane	2,668.5	188.9	3.3	**2,860.8**	0.35%	80.9%
	1	764-41-0	1,4-Dichloro-2-butene	2,400.0	160.0	3.3	**2,563.3**	0.31%	81.2%
	1	540-59-0	1,2-Dichloroethylene	2,004.1	5.9	4.1	**2,025.9**	0.25%	81.4%
	1	75-34-3	Ethylidene dichloride	1,925.5	9.3	11.0	**1,945.8**	0.24%	81.6%
	1	107-05-1	Allyl chloride	1,532.2	243.9	40.1	**1,820.5**	0.22%	81.9%
	1	—	Polychlorinated alkanes	157.2	431.8	50.5	**658.1**	0.08%	82.0%
Carc	1	563-47-3	3-Chloro-2-methyl-1-propene	172.6	26.2	11.5	**210.3**	0.03%	82.0%
	1	77-47-4	Hexachlorocyclopentadiene	123.2	28.7	4.6	**156.5**	0.02%	82.0%
Carc	1	58-89-9	1,2,3,4,5,6-Hexachlorocyclohexane (Lindane)	0.2	0.7	0.5	**1.0**	0.00%	82.0%
	1	110-57-6	trans-1,4-Dichloro-2-butene	0.0	0.0	0.1	**0.1**	0.00%	82.0%
			Subclass 1 column subtotals =	561,857.7	52,805.2	57,232.7	**671,570.0**	**82.0%**	
			Column subtotal percentages =	83.7%	7.9%	8.5%	100.0%		
B. Chlorinated Plus Other Halogens (subclass = 2):									
	2	76-13-1	Freon-113 (1,1,2-trichlorotrifluoroethane)	109,913.1	621.6	702.1	**111,266.8**	13.59%	95.6%
	2	75-45-6	Chlorodifluoromethane (HCFC-22)	2,601.9	254.6	4,916.7	**7,700.8**	0.94%	96.5%
	2	1717-00-6	1,1-Dichloro-1-fluoroethane (HCFC-141b)	1,229.8	808.4	4,701.2	**6,750.5**	0.82%	97.3%
	2	75-68-3	1-Chloro-1,1-difluoroethane (HCFC-142b)	94.0	28.4	3,124.6	**3,247.8**	0.40%	97.7%
	2	76-14-2	Dichlorotetrafluoroethane (CFC-114)	866.1	108.4	425.7	**1,404.1**	0.17%	97.9%
	2	75-71-8	Dichlorodifluoromethane (CFC-12)	278.8	233.4	665.4	**1,070.5**	0.13%	98.0%
	2	2837-89-0	2-Chloro-1,1,1,2-tetrafluoro-ethane (HCFC-124)	184.0	113.3	452.7	**769.6**	0.09%	98.1%
	2	75-69-4	Trichlorofluoromethane (CFC-11)	86.6	244.6	349.7	**667.8**	0.08%	98.2%
	2	34077-87-7	Dichlorotrifluoroethane	358.2	0.0	0.5	**358.7**	0.04%	98.3%
	2	353-59-3	Bromochlorodifluoromethane (Halon-1211)	337.3	0.0	2.3	**339.7**	0.04%	98.3%
	2	354-25-6	1-Chloro-1,1,2,2-tetra-fluoroethane (HCFC-124a)	16.6	0.0	298.3	**314.6**	0.04%	98.3%
	2	306-83-2	2,2-Dichloro-1,1,1-trifluoro-ethane (HCFC-123)	129.0	3.0	114.7	**236.6**	0.03%	98.4%
	2	76-15-3	Monochloropentafluoroethane (CFC-115)	89.3	7.1	36.4	**132.9**	0.02%	98.4%
	2	75-43-4	Dichlorofluoromethane (HCFC-21)	0.0	0.1	78.0	**76.4**	0.01%	98.4%
	2	1649-08-7	1,2-Dichloro-1,1-difluoro-ethane (HCFC-132b)	48.0	18.5	0.5	**67.0**	0.01%	98.4%
	2	354-23-4	1,2-Dichloro-1,1,2-trifluoro-ethane (HCFC-123a)	0.0	0.0	34.6	**34.8**	0.00%	98.4%
	2	75-88-7	2-Chloro-1,1,1-trifluoroethane (HCFC-133a)	0.0	8.3	17.1	**25.4**	0.00%	98.4%
	2	507-55-1	1,3-Dichloro-1,1,2,2,3-penta-fluoropropane (HCFC-225cb)	2.4	1.9	14.5	**18.8**	0.00%	98.4%
	2	422-56-0	3,3-Dichloro-1,1,1,2,2-penta-fluoropropane (HCFC-225ca)	2.0	1.5	12.0	**15.5**	0.00%	98.4%
	2	75-72-9	Chlorotrifluoromethane (CFC-13)	0.0	0.0	4.8	**4.8**	0.00%	98.4%
	2	75-27-4	Dichlorobromomethane	0.0	0.0	1.3	1.3	0.00%	98.4%
			Subclass 2 column subtotals =	116,227.1	2,453.0	15,953.1	134,504.3	16.4%	
			Column subtotal percentages =	86.4%	1.8%	11.9%	100.0%		
C. Chlorinated Plus Other Chemical Elements (Functional Groups) (subclass = 3):									
	3	108-60-1	Bis(2-chloro-1-methylethyl) ether	10,967.0	0.0	2.3	**10,969.4**	1.34%	99.8%
	3	111-44-4	Bis(2-chloroethyl) ether	766.7	312.3	1.5	**1,080.4**	0.13%	99.9%
	3	79-11-8	Chloroacetic acid	839.7	0.8	3.5	**843.1**	0.10%	100.0%
	3	76-06-2	Chloropicrin	15.1	0.2	6.0	**21.3**	0.00%	100.0%
	3	541-41-3	Ethyl chloroformate	5.8	0.0	2.4	**8.1**	0.00%	100.0%
Carc	3	107-30-2	Chloromethyl methyl ether	4.1	0.0	1.5	**5.6**	0.00%	100.0%
	3	111-91-1	Bis(2-chloroethoxy) methane	0.0	0.0	4.3	**4.3**	0.00%	100.0%
	3	79-22-1	Methyl chlorocarbonate	2.1	0.0	1.2	**3.3**	0.00%	100.0%
Carc	3	542-88-1	Bis(chloromethyl) ether	3.3	0.0	0.0	**3.3**	0.00%	100.0%
	3	2524-03-0	Dimethyl chlorothiophosphate	0.0	0.0	0.0	**0.0**	0.00%	100.0%
	3	76-02-8	Trichloroacetyl chloride	0.0	0.0	0.0	**0.0**	0.00%	100.0%
Carc	3	505-60-2	Mustard gas (1,1'-thiobis[2-chloro-] ethane)	0.0	0.0	0.0	**0.0**	0.00%	100.0%
	3	52-68-6	Trichlorfon (2,2,2-trichloro-1-hydroxyethyl)-dimethyl ester phosphonic acid)	0.0	0.0	0.0	**0.0**	0.00%	100.0%
			Subclass 3 column subtotals =	12,603.7	313.3	22.6	**12,938.7**	**1.6%**	
			Column subtotal percentages =	97.4%	2.4%	0.2%	100.0%		
			Column totals (all subclasses) =	690,688	55,572	73,208	819,013	100%	
			Column percents =	84.3%	6.8%	8.9%	100%		

Explanatory Notes:
(a) * TRI survey facilities in SIC codes 20-39 with > 9 full-time employees & which manufacture/process 25,000 lbs or use 10,000 lbs of TRI-listed chemicals per year.
(b) "Carc" denotes chemicals designated as known or suspected carcinogens by the OSHA (29 CFR 1910.1200), based on IARC, NTP and OSHA criteria.

ATTACHMENT B:

SUMMARY OF 1997 RCRA SECTION 3007 INDUSTRY SURVEY FINDINGS (1996 INDUSTRY REFERENCE DATA YEAR)

EXHIBIT B-1

USEPA 1999 CHLORINATED ALIPHATIC LISTING PROPOSAL
SUMMARY OF FACILITY CHARACTERIZATION SURVEY DATA COLLECTED FROM
23 CAHC-PRODUCING FACILITIES IN THE USA
USEPA-OSW'S 1997 RCRA SECTION 3007 SURVEY (1996 DATA YEAR; ALL CBI DATA MASKED)*

		1997 SURVEY SUMMARY STATISTICS				
	INDUSTRY SECTOR CHARACTERISTICS	MEDIAN	SIMPLE MEAN	STANDARD DEVIATION	TOTAL ALL FACILITIES	DATA POINTS
A.	**FACILITY LOCATION/SIZE:**					
A1	CAHC facility location=	NA	NA	NA	8 states	23
A2	Number CAHC manufacturing facility employees=	476	825	1,025	18,970	23
B.	**FACILITY CAHC PRODUCTION:**					
B1	Number CAHC products manufactured**=	1.0	2.6	3.0	22	23
B2	Number CAHC by-products from CAHC manufacturing process=	0.0	0.0	0.2		23
B3	Number CAHC intermediates formed in CAHC manufacturing process=	1.0	1.1	1.5		23
B4	Number non-CAHC by-products from CAHC manufacturing process=	0.0	0.0	0.2		23
B5	Average annual quantity CAHC product (Mtons/yr)=	288,776	315,246	308,140	6,935,417	22
C.	**FACILITY WASTE PRODUCTION & MANAGEMENT:**					
C1	Number CAHC manufacturing process wastestreams***=	5.0	4.7	2.2	109	23
C2	Number of CAHC wastestreams managed as hazardous=	0.0	0.9	1.8	20	23
C3	Number of waste management steps per CAHC wastestream+=	2.0	2.2	0.6	51	23
C4	Number of CAHC mfg. wastestreams managed on-site=	3.0	3.2	2.5	70	22
C5	Total liquid/gas waste quantity reported (MTons/yr)=	403,900	498,709	449,479	11,470,307	23
C6	Total sludge/solids quantity reported (MTons/yr)=	563	7,845	20,833	180,427	23
C7	Total annual waste quantity C5+C6 (MTons/yr)****=	406,925	506,554	449,910	$\boxed{\textbf{11,650,733}}$	23
C8	Worksheet-derived tons waste per ton CAHC product (C7/B5)=	1.7	8.6	19.8		22
D.	**FACILITY OFF-SITE WASTE MANAGEMENT:**					
D1	Number of CAHC-manufacturing wastestreams managed off-site=	1.0	1.7	1.7	37	23
D2	Number of offsite waste management unit locations used=	1.0	1.0	1.0	16	23
D3	One-way road distance to offsite waste management unit (miles)++=	26	137	221		13

Explanatory Notes:

(a) Data points = Number of 1997 Section 3007 survey facilities reporting data for each datafield.
(b) Average nr. employees per 212 facilities in LA+TX for SIC 2821+2869 = 260 (source: 1995 County Bus.Patterns).
(c) Survey responses reflect industry conditions in data year 1996; not necessarily representative of current conditions.
(d) * OMB Information Collection Request (survey) clearance no. 2050-0042, expired 31 Jan 1994.
(e) ** Does not include quantities of intermediate CAHCs (chlorinated aliphatic hydrocarbon compounds) manufactured. "Product" defined as CAHCs which exit the facility; intermediate defined as CAHC's consumed within the facility. In many cases, CAHC-manufacturing facilities may have other non-CAHC manufacturing operations at the same facility; information on other chemical products not collected in the USEPA 1996 Section 3007 survey.
(f) *** Number of process waste generation and subsequent on-site treatment residual streams per facility.
(g) **** USEPA-OSW standardized waste quantities reported in the Section 3007 survey to metric tons (1 MT= 2,205 lbs).
(h) +Waste management "steps" refer to the number of sequential onsite storage/treatment/disposal steps, plus any off-site transfer per wastestream (but does not include off-site management steps if applicable). Management train steps defined in the survey according to USEPA-TRI reporting codes (i.e. Cxx, Mxx and Txxx).
(i) ++ Refer to companion worksheet for supporting offsite transport distance data (non-CBI) extracted from the Section 3007 survey.
(j) The US-average truck haul distance for chemicals is reportedly 260 miles (OTA, July 1986, p.22).
(k) For explanation of the five statistical indicators (columns) summarized above, refer to text of the Economics Background Document.

EXHIBIT B-2

USEPA 1999 CHLORINATED ALIPHATIC LISTING PROPOSAL
SUMMARY OF WASTE SOURCES AND WASTE MANAGEMENT METHODS
FOR 23 SURVEY FACILITIES WHICH MANUFACTURE CAHCs.
BASED ON USEPA-OSW'S 1996 RCRA SECTION 3007 SURVEY DATA

Item	Survey code		Waste subtotals	% of waste
A. SOURCE/TYPE OF CAHC MANUFACTURING WASTESTREAM:				
1	C3	Treatment sludges (biological or other)	CBI protected	CBI
2	C8	Untreated process wastewater (acid, caustic or neutral)	CBI protected	CBI
3	C15	Miscellaneous wastewater*	CBI protected	CBI
4	C16	Spent scrubber liquid (aqueous and/or organic)	CBI protected	CBI
5	C18	Solids from treatment of other residuals	CBI protected	CBI
6		Not classified by survey respondent	CBI protected	CBI
		Column subtotal =	**11,651,297**	**100.0%**
B. TYPE OF WASTE MANAGEMENT UNITS (ONSITE & OFFSITE):				
		B1. Primary Waste Management Unit		
1	M1	Storage in tanks, containers, and/or waste piles	CBI protected	CBI
2	M2	Treatment**	CBI protected	CBI
3	M8	Onsite wastewater treatment***	CBI protected	CBI
		Column subtotal =	**10,983,358**	**94.3%**
		B2. Secondary Waste Management Unit		
1	M4	Recovery/reclamation/reuse	CBI protected	CBI
2	M8	Onsite wastewater treatment***	CBI protected	CBI
		Column subtotal =	**5,545,354**	**47.6%**
		B3. Tertiary Waste Management Unit		
1	M8	Onsite wastewater treatment***	CBI protected	CBI
		Column subtotal =	CBI protected	CBI
		B4. Quaternary Waste Management Unit		
1	M4	Recovery/reclamation/reuse	CBI protected	CBI
2	M5	Incineration	CBI protected	CBI
3	M6	Landfill	CBI protected	CBI
4	M7	Underground injection	CBI protected	CBI
5	M9	Discharge to publicly-owned wastewater treatment unit	CBI protected	CBI
6	M10	Discharge to surface water under NPDES	CBI protected	CBI
7	M11	Discharge to offsite privately-owned treatment unit	CBI protected	CBI
8	M15	Land treatment/application (landfarming)	CBI protected	CBI
		Column subtotal =	**11,651,297**	**100.0%**
C. TYPE OF WASTE TREATMENT TECHNOLOGY (ONSITE & OFFSITE):				
		C1. Primary Waste Treatment Technology		
1	T039	Other recovery	CBI protected	CBI
2	T042	Incineration (sludges)	CBI protected	CBI
3	T043	Incineration (solids)	CBI protected	CBI
4	T077	Aqueous inorganic treatment (chemical precipitation)	CBI protected	CBI
5	T081	Aqueous organic treatment (biological treatment)	CBI protected	CBI
6	T082	Aqueous organic treatment (carbon adsorption)	CBI protected	CBI
7	T083	Aqueous organic treatment (air/steam stripping)	CBI protected	CBI
8	T091	Aqueous organic & inorganic treatment (chem.prec. + bio.trtmnt)	CBI protected	CBI
9	T094	Aqueous organic & inorganic treatment (other method n.e.c.)	CBI protected	CBI
10	T101	Sludge treatment (dewatering)	CBI protected	CBI
11	T121	Other treatment (neutralization only)	CBI protected	CBI
12	T125	Other treatment (n.e.c.)	CBI protected	CBI
		Column subtotal =	**10,284,645**	**88.3%**
		C2. Secondary Waste Treatment Technology		
1	T081	Aqueous organic treatment (biological treatment)	CBI protected	CBI
2	T082	Aqueous organic treatment (carbon adsorption)	CBI protected	CBI
3	T083	Aqueous organic treatment (air/steam stripping)	CBI protected	CBI
4	T085	Aqueous organic treatment (n.e.c.)	CBI protected	CBI
5	T121	Other treatment (neutralization only)	CBI protected	CBI
6	T123,T124	Other treatment (settling/clarification + phase separation)	CBI protected	CBI
7	T125	Other treatment (n.e.c.)	CBI protected	CBI
		Column subtotal =	**5,349,314**	**45.9%**

Explanatory Notes:
(a) * Wastewaters from equipment washdown, boiler blowdown, and/or other non-process wastewater.
(b) ** Treatment in tanks, containers, surface impoundments, waste piles and/or other unit(s).
(c) *** Wastewater treatment in tanks, surface impoundment, containers and/or other unit(s).
(d) Note: This spreadsheet table is contained within a USEPA-OSW, CBI-controlled electronic file.

EXHIBIT B-3

USEPA 1999 CHLORINATED ALIPHATIC LISTING PROPOSAL
ONSITE WASTE MANAGEMENT PROFILE OF 23 CAHC-PRODUCING FACILITIES
RESPONDING TO USEPA-OSW'S 1997 RCRA SECTION 3007 SURVEY*
WASTE MANAGEMENT RELATED TO CAHC PRODUCTION ONLY

Item	Type of Onsite Waste Management Unit(s) Used for Handling CAHC Manufacturing Wastes (summary statistics per-facility)	1997 SURVEY SUMMARY STATISTICS						
		YES	NO	MEDIAN	SIMPLE MEAN	STNDRD DEVTN	TOTAL ALL FACILITIES	DATA POINTS**
A.	**Tanks:**							
	Number of waste/residual tanks per facility =	15		1	2.1	3.0	58	23
	Estimated total capacity of tanks per facility + (gals) =	NA	NA	550,000	1,469,667	2,320,728	22,045,000	15
	Implied average capacity per tank (gals) =	NA	NA	100,000	305,829	292,013		15
	Are tanks part of treatment train? (Yes/No) =	13	2	NA	NA	NA		15
	Are some tanks w/secondary roof/cover? (Yes/No) =	5	8	NA	NA	NA		13
	Are some tanks w/secondary containment? (Yes/No) =	11	5	NA	NA	NA		15
B.	**Containers:**							
	Number of wastestreams handled using containers =	13	13	1	0.7	0.7	17	23
	Total (max.) container daily quantity + + (gals) =	NA	NA	3,300	8,321	16,093	99,850	12
	Container storage area concrete base material?(Yes/No) =	11	2	NA	NA	NA		13
	Collect surface runoff from container area? (Yes/No) =	5	8	NA	NA	NA		13
C.	**Storage Piles:**							
	Number of waste piles per facility =	1	22	CBI	CBI	CBI	1	23
	Typical waste quantity managed (cubic yards) =	1	22	CBI	CBI	CBI	CBI	1
	Storage pile(s) under roofed structure? (Yes/No) =	CBI	CBI	CBI	CBI	CBI	CBI	1
	Storage pile(s) w/leachate/runoff containment? (Yes/No) =	CBI	CBI	CBI	CBI	CBI	CBI	1
	Storage pile(s) with synthetic liner base? (Yes/No) =	CBI	CBI	CBI	CBI	CBI	CBI	1
D.	**Boiler/Kiln/Furnace:**							
	Nr. of waste boilers/kilns/furnaces*** =	1	22	CBI	CBI	CBI	1	23
	Total capacity (ton/yr) =	NA	NA	CBI	CBI	CBI	CBI	1
E.	**Incineration:**							
	Number of waste incinerators per facility =	1	22	CBI	CBI	CBI	1	23
	Total incinerator capacity per facility (ton/yr) =	NA	NA	CBI	CBI	CBI	CBI	1
F.	**Land Application (Landfarming):**							
	Number of land application units per facility =	2	21	CBI	CBI	CBI	2	23
	Total land application size per facility (acres) =	CBI	CBI	CBI	CBI	CBI	CBI	2
	Collect surface water runoff from landfarming? (Yes/No) =	CBI	CBI	CBI	CBI	CBI	CBI	2
G.	**Surface Impoundments:**							
	Number of surface impoundments per facility =	0	23	NA	NA	NA	0	23
	Total daily capacity (gals) =	NA	NA	NA	NA	NA		NA
	Total impoundment size (acres) =	NA	NA	NA	NA	NA		NA
	Synthetic liner? (Yes/No) =	NA	NA	NA	NA	NA		NA
	Clay liner? (Yes/No) =	NA	NA	NA	NA	NA		NA
	Leachate collection system? (Yes/No) =	NA	NA	NA	NA	NA		NA
H.	**Landfills (on-site):**							
	Number of waste landfills per facility =	3	20	NA	NA	NA	5	23
	Total landfill capacity per facility (cubic yards) =	3	20	CBI	505,833	170,037	1,517,500	3
	Synthetic liner? (Yes/No) =	2	1	CBI	CBI	CBI	CBI	3
	Clay liner? (Yes/No) =	2	1	CBI	CBI	CBI	CBI	3
	Leachate collection system? (Yes/No) =	2	1	CBI	CBI	CBI	CBI	3
I.	**Underground Injection (Well):**							
	Number of injection wells per facility =	2	21	CBI	CBI	CBI	CBI	23
	Average injection well depth (feet) =	NA	NA	CBI	CBI	CBI	CBI	2

Explanatory Notes:
(a) Data points = Number of 1997 RCRA Section 3007 survey facilities reporting data for each datafield (data year = 1996).
(b) "YES", "NO" = Number of survey facilities reporting use of particular WMU.
(c) NA = Not applicable to particular summary (row/column cell).
(d) Survey responses reflect industry conditions in 1996; not necessarily representative of current conditions.
(e) * OMB Information Collection Request (survey) clearance no. 2050-0042, expired 31 Jan 1994.
(f) ** Nr. of data points may be < 23 facilities because WMU not applicable or no response provided in survey.
(g) *** One facility reported use of a "thermal oxidation" treatment method not included in this table.
(h) + Total tank capacity imputed by OSW-EMRAD using midpoint of 0-10k or 10k-100k gallon survey code ranges.
(i) + + Total container capacity imputed by EMRAD using midpoint of survey code range.
(j) Only on-site waste management practices applied to residuals of concern to listing (wastewaters, ww treatment sludges) included.

EXHIBIT B-4

USEPA'S 1999 RCRA CHLORINATED ALIPHATICS LISTING PROPOSAL
SHIPMENT OF CHLORINATED ALIPHATIC PRODUCTION PROCESS WASTES OFFSITE (LIQUIDS & SOLIDS)*
SUMMARY OF NON-CBI 1997 RCRA SECTION 3007 SURVEY DATA

Item	CAHC Manufacturing Company Name	Facility city location	State	Annual CAHC process waste (Mt)	Annl waste quantity managed offsite (MT)	Offsite waste management shipment destination City	State	Shiping distance website raw data (miles)	One-way shipment distance (miles)**
1	Borden Chemicals & Plastics	Giesmar	LA	403,900	3,024.0	See 1a-1b below			
	Subtotal (1a)				2,904.0	Sorrento	LA	9	10.8
	Subtotal (1b)				120.0	Sulphur	LA	140	168.0
2	Condea Vista	Westlake	LA	696,018	18.3	Deer Park	TX	118	141.6
3	Dow Corning Corp.	Midland	MI	24,500	24,500.0	Midland	MI	5	6.0
4	DuPont-Dow Elastomers	Laplace	LA	496,991	606.0	See 4a-4b below			
	Subtotal (4a)				596.0	Orange	TX	197	236.4
	Subtotal (4b)				10.0	Eldorado	AR	493	591.6
5	Formosa Plastics Corp USA	Baton Rouge	LA	833,700	700.0	Walker	LA	16	19.2
6	Formosa Plastics Corp USA	Point Comfort	TX	CBI	CBI	CBI	CBI	CBI	CBI
7	Geon Company	LaPorte	TX	964,754	1,804.0	Houston	TX	22	26.4
8	Occidental Chemicals Corp.	Convent	LA	223,500	500.0	Sorrento	LA	12	14.4
9	Occidental Chemicals Corp.	Deer Park	TX	695,696	695,695.0	See 9a-9e below			
	Subtotal (9a)				360,349.0	Deer Park	TX	5	6.0
	Subtotal (9b)				19.0	Anahuac	TX	27	32.4
	Subtotal (9c)				60.0	Deer Park	TX	5	6.0
	Subtotal (9d)				442.0	Waynoka	OK	523	627.6
	Subtotal (9e)				334,825.0	Deer Park	TX	5	6.0
10	Occidental Chemicals Corp.	Gregory	TX	157,660	160.0	Sinton	TX	15	18.0
11	Occidental ("Oxymar")	Gregory	TX	500,077	1,445.0	See 11a-11b below			
	Subtotal (11a)				820.0	Altair	TX	124	148.8
	Subtotal (11b)				625.0	Robstown	TX	24	28.8
12	PPG Industries Inc.	Lake Charles	LA	584,101	2,200.0	Sulphur	LA	9	10.8
13	Shell Chemical Products	Norco	LA	381,125	3,630	Sorrento	LA	30	36.0
14	Vulcan Chemical Co.	Wichita	KS	CBI	CBI	Baton Rouge	LA	613	735.6
15	Westlake Monomers	Calvert City	KY	CBI	CBI	Calvert City	KY	5	6.0
Statistical Summary (non-CBI data):		Non-CBI totals =		5,962,022	734,282	16	6		
		Non-CBI median =		498,534	625				26.4
		Non-CBI mean =		496,835	38,646				137.0
		Non-CBI stnd.dvtn =		266,794	106,181				220.7
		Waste quantity weighted mean (non-CBI) =							3.6

Explanatory Notes:
(a) Mt = metric tons per year (1.0 Mt = 1,000 kilograms = 2,204.6 pounds = 1.102 short tons).
(b) * Eleven other RCRA Section 3007 survey facilities not listed above because did not report offsite shipment of either wastewaters or wastewater sludges within the waste type scope of the 1999 listing proposal (as of 1996).
(c) * OSW-EMRAD estimated one-way distances by multiplying linear distances generated using the internet website http://www.indo.com/distance/, by a non-linear actual travel route factor = 1.2.
(d) OSW-EMRAD assigned average linear miles to offsite waste management distances located within the same city = 5.0.

ATTACHMENT C:

ESTIMATED SUBTOTAL INDUSTRY COMPLIANCE COSTS FOR THE SLUDGE WASTE CATEGORY (WASTECODES K174 & K175) OF THIS RCRA LISTING PROPOSAL

EXHIBIT C-1

USEPA-OSW Chlorinated Aliphatic RCRA-Listing Project
Universe of CAHC Producers in the United States (1996 data yr.)

A. BASELINE DATA:

Facility Item	Company Name	City	State	Wastewater Characterization: EDC/VCM wastewater quantity* (Mtons/yr)	Dedicated or non-dedicated wastestream	Percent from CA process	Waste water from CA process (Mtons/yr)
1	Borden Chemicals	Giesmar	LA	785,400	Dedicated	51.4%	403,900
2	Condea Vista	Westlake	LA	4,481,000	Non-dctd	15.5%	696,000
3	Dow Chemical	Freeport	LA	57,200,000	Non-dctd	1.2%	660,011
4	Dow Chemical	Plaquemine	LA	32,710,000	Non-dctd	5.7%	1,872,000
5	Dow Corning	Carrolton	NY	959,000	Non-dctd	18.4%	176,000
6	Dow Corning	Midland	MI	24,500	Dedicated	100.0%	24,500
7	DuPont-Dow Elastomers	LaPlace	LA	496,360	Dedicated	100.0%	496,360
8	DuPont-Dow Elastomers	Louisville	KY	CBI	Non-dctd	CBI	CBI
9	FMC	Baltimore	MD	CBI	Non-dctd	CBI	CBI
10	Formosa Plastics	Baton Rouge	LA	5,433,000	Non-dctd	15.3%	833,000
11	Formosa Plastics	Point Comfort	TX	11,670,000	Non-dctd	7.7%	900,000
12	General Electric	Waterford	NY	CBI	Non-dctd	CBI	CBI
13	Geon	LaPorte	TX	962,950	Dedicated	100.0%	962,950
14	Georgia Gulf	Plaquemine	LA	3,513,000	Non-dctd	35.7%	1,253,000
15	Occidental Chemical	Convent	LA	223,000	Dedicated	100.0%	223,000
16	Occidental Chemical	Deer Park	TX	695,255	Dedicated	100.0%	695,255
17	Occidental/Oxymar	Gregory	TX	656,100	Dedicated	100.0%	656,100
18	PPG	Lake Charles	LA	1,636,600	Dedicated	38.2%	625,350
19	Shell Chemicals	Norco	LA	4,154,000	Non-dctd	1.5%	64,000
20	Velsicol Chemicals	Memphis	TN	675,915	Non-dctd	10.0%	67,800
21	Vulcan Chemicals	Geismar	LA	CBI	Non-dctd	CBI	CBI
22	Vulcan Chemicals	Witchita	KS	1,203,700	Non-dctd	CBI	CBI
23	Westlake Monomers	Calvert City	KY	298,000	Dedicated	100.0%	298,000

B. SUMMARY STATISTICS (non-CBI data only):

		EDC/VCM wastewater quantity (Mtons/yr)	Percent from CA process	Waste water from CA process (Mtons/yr)
B1	Minimum =	24,500	1.2%	24,500
B2	Maximum =	57,200,000	100.0%	1,872,000
B3	Mean =	5,772,000	38.6%	477,000
B4	Median =	785,000	15.5%	403,900
B7	Column totals =	**127,778,000**		10,907,000

C. TOTAL WITH CBI DATA**: **11,513,760**

D. EXPLANATORY NOTES:

(1) Source: "Chlorinated Aliphatics Listing Determination Risk Assessment Human Health", RTI, 30 June 1998, and
** 30 July 1999 USEPA-OSW "Listing Background Document" (Appdx D, Table D-1, pp.195-196).

(2) * Wastewater quantity associated with facility "headworks", which may represent at least two comingled wastestreams:
(1) CAHC wastewaters, and (2) other chemical production wastewaters originating from different facility operations.
Headworks may be "dedicated" (only one process or not comingled), or "non-dedicated" (multiple processes or if comingled).

(3) CBI = Confidential Business Information, claimed by survey respondent to USEPA-OSW's 1997 Section 3007 Industry Survey.

(4) Mtons= Metric tons = 2,204 pounds = 1.102 short tons (short ton = 2,000 pounds).

EXHIBIT C-2

USEPA-OSW Chlorinated Aliphatic RCRA-Listing Project
Universe of EDC-VCM Producers in the United States (1996 Data Year)

A. BASELINE DATA:

Facility Item	Company Name	City	State	Wastewater Characterization: Facility wastewater quantity* (Mtons/yr)	Dedicated or non-dedicated wastestream	Percent from CA process	Waste water from CA process (Mtons/yr)	Wastewater Sludge Management (Mtons/yr): On-site Non-Haz Landfill	On-site Haz Landfill	On-site Non-Haz Land App.	Offsite Non-Haz Landfill	Offsite Haz Landfill	Sludge Row totals	CA only process sludge	CA sludge weight% of CA WW
1	Borden Chemicals	Giesmar	LA	785,400	Dedicated	51.4%	403,900				2,904.0		2,904.0	311.0	0.077%
2	Condea Vista	Westlake	LA	4,481,000	Non-dctd	15.5%	696,000					18.3	18.3	2.7	0.000%
3	Dow Chemical	Freeport	LA	57,200,000	Non-dctd	1.2%	660,011	72,223.0	5,672.0				77,895.0	101.0	0.015%
4	Dow Chemical	Plaquemine	LA	32,710,000	Non-dctd	5.7%	1,872,000	11,100.0					11,100.0	96.0	0.005%
5	Formosa Plastics	Baton Rouge	LA	5,433,000	Non-dctd	15.3%	833,000				700.0		700.0	107.0	0.013%
6	Formosa Plastics	Point Comfort	TX	11,670,000	Non-dctd	7.7%	900,000				3,688.0		3,688.0	284.0	0.032%
7	Geon	LaPorte	TX	962,950	Dedicated	100.0%	962,950				1,804.0		1,804.0	1,804.0	0.187%
8	Georgia Gulf	Plaquemine	LA	3,513,000	Non-dctd	35.7%	1,253,000			1,750.0			1,750.0	624.0	0.050%
9	Occidental Chemical	Convent	LA	223,000	Dedicated	100.0%	223,000				500.0		500.0	500.0	0.224%
10	Occidental Chemical	Deer Park	TX	695,255	Dedicated	100.0%	695,255					442.0	442.0	442.0	0.064%
11	Occidental/Oxymar	Gregory	TX	656,100	Dedicated	100.0%	656,100				980.0	625.0	1,605.0	1,605.0	0.245%
12	PPG	Lake Charles	LA	1,636,600	Dedicated	38.2%	625,350				2,200.0		2,200.0	581.0	0.093%
13	Vulcan Chemicals	Geismar	LA	CBI	Non-dctd	8.0%	CBI						0.0	0.0	CBI
14	Westlake Monomers	Calvert City	KY	298,000	Dedicated	100.0%	298,000						0.0	0.0	0.000%

B. SUMMARY STATISTICS (non-CBI data only):

		Facility wastewater quantity* (Mtons/yr)	Percent from CA process	Waste water from CA process (Mtons/yr)	On-site Non-Haz Landfill	On-site Haz Landfill	On-site Non-Haz Land App.	Offsite Non-Haz Landfill	Offsite Haz Landfill	Sludge Row totals	CA only process sludge	CA sludge weight% of CA WW
B1	Minimum =	223,000	1.2%	223,000	11,100	5,672	1,750	500	18	0	0	0.000%
B2	Maximum =	57,200,000	100.0%	1,872,000	72,223	5,672	1,750	3,688	625	77,895	1,804	0.245%
B3	Mean =	9,191,000	48.3%	744,000						7,500	500	0.072%
B4	Median =	1,300,000	36.9%	677,633						1,678	298	0.041%
B7	Column totals =	**120,264,000**		**10,079,000**	83,323	5,672	1,750	12,776	1,085	**104,606**	**6,458**	
B6	Column percents of total =				80%	5%	2%	12%	1%	100%		

C. EXPLANATORY NOTES:

(1) Source: "Chlorinated Aliphatics Listing Determination Risk Assessment Human Health", RTI, 30 June 1998, and 30 July 1999 USEPA-OSW "Listing Background Document".

(2) * Wastewater quantity associated with facility "headworks", which may represent at least two comingled wastestreams prior to management: (1) CAHC wastewaters, and (2) other chemical production (non-CA) wastewaters, each originating from different facility operations. Headworks may be "dedicated" (if only one process or not comingled), or "non-dedicated" (if multiple processes or if comingled).

(3) The scope of OSW's RCRA-listing project includes other chlorinated aliphatic processes not shown above, in addition to EDC/VCM production.

(4) CBI = Confidential Business Information, claimed by survey respondent to USEPA-OSW's 1997 Section 3007 Industry Survey.

(5) Mtons= Metric tons = 2,204 pounds = 1.102 short tons (short ton = 2,000 pounds).

EXHIBIT C-3

USEPA-OSW CHLORINATED ALIPHATIC RCRA-LISTING PROPOSAL FACILITY COMPLIANCE COST FOR EDC/VCM PROCESSES: PRELIMINARY ESTIMATE (14 FACILITIES WITH 20 PROCESSES)
>>>IF WASTES CONTINUE TO BE COMINGLED AFTER LISTING

Waste volumes from EDC-VCM production >>>

Waste Type	metric tons/yr	short* tons/yr
WASTESTREAM		
DERIVED SLUDGE	**129,375**	142,571
DERIVED WWATER		

Item	Waste Management Steps	Type of Waste	Waste Management Method or Computation Item	Comment	Waste quantity (sh-tons/yr)	Management unit cost ($/ton)**	Average annual cost/impact
A.	**EX ANTE WASTE MANAGEMENT (INTIALLY ASSUMED CURRENT 3-STEP TRAIN):**						
A1	Step-1	WASTESTREAM	Preliminary/Primary/Secondary Treatment	Not incremental			
A2	Step-2	DERIVED WWATER	Discharge to PrOTW or POTW	Not incremental			
A3	Step-3	DERIVED SLUDGE	Deposit in Subtitle D non-haz landfill offsite (or LTU)		142,571	$50	$7,128,560
A4				Total cost A=			$7,128,560
B.	**EX POST WASTE MANAGEMENT (IF RCRA-LISTED WITH ASSUMED 4-STEP TRAIN):**						
B1	Step-1	WASTESTREAM	Preliminary/Primary/Secondary Treatment	Not incremental			
B2	Step-2	DERIVED WWATER	Discharge to PrOTW or POTW	Not incremental			
B3	Step-3	DERIVED SLUDGE	Incineration (commercial offsite bulk pumpable sludge unit cost)		142,571	$625	$89,107,030
B4	Step-4	INCINERTED SLUDGE (ASH)	Deposit in RCRA Subtitle C haz landfill offsite	(20% of sludge qnty***)	28,514	$130	$3,706,850
B5				Total cost B=			$92,813,880
C.	**ESTIMATED INCREMENTAL FACILITY COST OF RCRA LISTING (B-A):**						
C1			Incremental cost (1995$) to all EDC/VCM facilities (B7-A5)=				$85,685,000
C2			Incremental cost updated to 1998$****=				**$92,751,000**
C3			Cost range with +/-25% estimation uncertainty applied =			**$69,563,000**	**$115,939,000**
D.	**FINANCIAL IMPACT OF INCREMENTAL COST ON FACILITY:**						
D1			USITC 1994 US average unit value (sale price) of EDC/VCM product ($/lb)=				$0.2175
D2A			USITC 1994 annual quantity EDC/VCM product sales by all facilities (short tons)=				3,324,400
D2B			EDC/VCM product sales, excluding the VCM-LTU and VCM-A facilities=				3,054,800
D3			Estimated annual sales revenue from EDC/VCM sales (D1 x 2000 x D2)=				$1,328,838,000
D4			Incremental cost as percent of annual EDC/VCM sales revenues (C2/D3)=				7%
D5			Estimated annual net profit from EDC/VCM sales (D3 x net profit rate)=				$97,005,000
D6			Incremental cost as percent of annual net sales profit (C2/D5)=				**96%**
D7			Net profit comparison range with +/-25% uncertainty (C3/D5)=			**72%**	**120%**

Explanatory Notes:

(a)	* Short ton = 2,000 pounds (lbs); Metric ton = 2,204 lbs.	
(b)	** Waste management unit costs from HWIR Cost-Benefit Assessment, Exhibit 3-2, p.3-5, 25 May 1995 (derived from LDR study). For purpose of preliminary estimation, national average unit costs for waste treatment, rather than regional- and facility/process-specific costs are applied above.	
(c)	*** Incineration ash reportedly ranges from 10% to 30% of sludge weight; midpoint of this range applied in computation above =	20%
(d)	**** 1995-based incremental cost updated from 1995$ to 1998$ with the ENR Cost Index multiplier=	1.082
(e)	Incremental costs in section C above rounded to nearest thousand dollars.	
(f)	+/- Uncertainty range applied to point estimate (to reflect underlying data and computation uncertainty) =	25%
(g)	Waste management unit costs inclusive of average distance off-site transportation costs.	
(h)	Waste management costs common to both ex-ante & ex-post (if equal tons) not required for incremental analysis.	
(i)	Net profit rate from industrial chemical & synthetics sales revenue, based on 1995-1998 average for SIC codes 282+282+286 =	7.3%
(j)	Ex-ante financial impact analysis above is illustrative only, based on EMRAD estimates rather than CBI data; actual ex-post profit impact to affected facilities depends on market structure and price elasticity of demand.	
(k)	Average US market price (in $/pound, April 1999) quoted from "ChemExpo" http://www.chemexpo.com/news/PROFILE980216.cfm	

EXHIBIT C-4

USEPA-OSW CHLORINATED ALIPHATIC RCRA-LISTING PROPOSAL
FACILITY COMPLIANCE COST FOR EDC/VCM PROCESSES:
PRELIMINARY ESTIMATE (14 FACILITIES WITH 20 PROCESSES)
>>>IF WASTES ARE SEGREGATED AFTER LISTING

Waste volumes from EDC-VCM production >>>

Waste Type	metric tons/yr	short* tons/yr	
WASTESTREAM			
DERIVED SLUDGE	**11,926**	13,142	(from Table 3)
DERIVED WWATER			

Item	Waste Management Steps	Type of Waste	Waste Management Method or Computation Item	Comment	Waste quantity (sh-tons/yr)	Management unit cost ($/ton)**	Average annual cost/impact
A.	**EX ANTE WASTE MANAGEMENT (INTIALLY ASSUMED CURRENT 3-STEP TRAIN):**						
A1	Step-1	WASTESTREAM	Preliminary/Primary/Secondary Treatment	Not incremental			
A2	Step-2	DERIVED WWATER	Discharge to PrOTW or POTW	Not incremental			
A3	Step-3	DERIVED SLUDGE	Deposit in Subtitle D non-haz landfill offsite (or LTU)		11,926	$50	$596,300
A4				Total cost A=			$596,300
B.	**EX POST WASTE MANAGEMENT (IF RCRA-LISTED WITH ASSUMED 4-STEP TRAIN):**						
B1	Step-1	WASTESTREAM	Preliminary/Primary/Secondary Treatment	Not incremental			
B2	Step-2	DERIVED WWATER	Discharge to PrOTW or POTW	Not incremental			
B3	Step-3	DERIVED SLUDGE	Incineration (commercial offsite bulk pumpable sludge unit cost)		11,926	$625	$7,453,740
B4	Step-4	INCINERTED SLUDGE (ASH)	Deposit in RCRA Subtitle C haz landfill offsite	(20% of sludge qnty***)	2,385	$130	$310,080
B5				Total cost B=			$7,763,820
C.	**ESTIMATED INCREMENTAL FACILITY COST OF RCRA LISTING (B-A):**						
C1			Incremental cost (1995$) to all EDC/VCM facilities (B7-A5)=				$7,168,000
C2			Incremental cost updated to 1998$****=				**$7,759,000**
C3			Cost range with +/-25% estimation uncertainty applied =			**$5,819,000**	**$9,699,000**
D.	**FINANCIAL IMPACT OF INCREMENTAL COST ON FACILITY:**						
D1			USITC 1994 US average unit value (sale price) of EDC/VCM product ($/lb)=				$0.2175
D2A			USITC 1994 annual quantity EDC/VCM product sales by all facilities (short tons)=				3,324,400
D2B			EDC/VCM product sales, excluding the VCM-LTU and VCM-A facilities=				3,054,800
D3			Estimated annual sales revenue from EDC/VCM sales (D1 x 2000 x D2)=				$1,328,838,000
D4			Incremental cost as percent of annual EDC/VCM sales revenues (C2/D3)=				0.6%
D5			Estimated annual net profit from EDC/VCM sales (D3 x net profit rate)=				$97,005,000
D6			Incremental cost as percent of annual net sales profit (C2/D5)=				**8%**
D7			Net profit comparison range with +/-25% uncertainty (C3/D5)=			**6%**	**10%**

Explanatory Notes:

(a)	* Short ton = 2,000 pounds (lbs); Metric ton = 2,204 lbs.	
(b)	** Waste management unit costs from HWIR Cost-Benefit Assessment, Exhibit 3-2, p.3-5, 25 May 1995 (derived from USEPA's LDR study). For purpose of preliminary estimation, national average unit costs for waste treatment, rather than regional- and facility/process-specific costs are applied above. Incineration unit cost represents national average supplied by Environmental Technology Council, to USEPA-OSW-EMRAD (per P.Balserak memo 08 Feb 1999).	
(c)	*** Incineration ash reportedly ranges from 10% to 30% of sludge weight; midpoint of this range applied in computation above =	20%
(d)	**** 1995-based incremental cost updated from 1995$ to 1998$ with the ENR Cost Index multiplier=	1.082
(e)	Incremental costs in section C above rounded to nearest thousand dollars.	
(f)	+/- Uncertainty range applied to point estimate (to reflect underlying data and computation uncertainty) =	25%
(g)	Waste management unit costs inclusive of average distance off-site transportation costs.	
(h)	Waste management costs common to both ex-ante & ex-post (if equal tons) not required for incremental analysis.	
(i)	Net profit rate of chemical sales revenue applied above based on 1995 national average for SIC codes 2821+2869 =	7.3%
(j)	Ex-ante financial impact analysis above is illustrative only, based on EMRAD estimates rather than CBI data; actual ex-post profit impact to affected facilities depends on market structure and price elasticity of demand.	
(k)	Average US market price (in $/pound, April 1999) quoted from "ChemExpo" http://www.chemexpo.com/news/PROFILE980216.cfm	

EXHIBIT C-5

USEPA-OSW CHLORINATED ALIPHATIC RCRA-LISTING PROPOSAL
FACILITY COMPLIANCE COST FOR EDC/VCM PROCESSES:
PRELIMINARY ESTIMATE (SINGLE FACILITY USING LAND APPLICATION)

Waste volumes from EDC-VCM production >>>

Waste Type	metric tons/yr	short* tons/yr
WASTESTREAM		
DERIVED SLUDGE	**1,750**	1,929
DERIVED WWATER		

Item	Waste Management Steps	Type of Waste	Waste Management Method or Computation Item	Comment	Waste quantity (sh-tons/yr)	Management unit cost ($/ton)**	Average annual cost/impact
A	**EX ANTE WASTE MANAGEMENT (INITIALLY ASSUMED CURRENT 3-STEP TRAIN):**						
A1	Step-1	WASTESTREAM	Preliminary/Primary/Secondary Treatment	Not incremental			
A2	Step-2	DERIVED WWATER	Discharge to PrOTW or POTW	Not incremental			
A3	Step-3	DERIVED SLUDGE	Land Application		1,929	$13	$24,110
A4				Total cost A=			$24,110
B.	**EX POST WASTE MANAGEMENT (IF RCRA-LISTED WITH ASSUMED 4-STEP TRAIN):**						
B1	Step-1	WASTESTREAM	Preliminary/Primary/Secondary Treatment	Not incremental			
B2	Step-2	DERIVED WWATER	Discharge to PrOTW or POTW	Not incremental			
B3	Step-3	DERIVED SLUDGE	Incineration (commercial offsite bulk pumpable sludge unit cost)		1,929	$625	$1,205,310
B4	Step-4	INCINERATED SLUDGE (ASH)	Deposit in Subtitle C haz landfill offsite	(20% of sludge qnty***)	386	$130	$50,140
B5				Total cost B=			$1,255,450
C.	**ESTIMATED INCREMENTAL FACILITY COST OF RCRA LISTING (B-A):**						
C1			Incremental cost (1995$) to EDC/VCM producing facility (B7-A5)=				$1,231,000
C2			Incremental cost updated to 1998$****=				**$1,333,000**
C3			Cost range with +/-25% estimation uncertainty applied =			**$1,000,000**	**$1,666,000**
D.	**FINANCIAL IMPACT OF INCREMENTAL COST ON FACILITY:**						
D1			1998 US average price of VCM product ($/lb)=				$0.2175
D2			EMRAD estimated annual quantity VCM product sales for single facility (short tons)=				688,800
D3			Estimated annual sales revenue from EDC/VCM sales (D1 x 2000 x D2)=				$299,628,000
D4			Incremental cost as percent of annual EDC/VCM sales revenues (C2/D3)=				0.4%
D5			Estimated annual net profit from VCM sales (D3 x net profit rate)=				$16,210,000
D6			Incremental cost as percent of annual net sales profit (C2/D5)=				**8.2%**
D7			Net profit comparison range with +/-25% uncertainty (C3/D5)=			**6.2%**	**10.3%**

Explanatory Notes:

(a) * Short ton = 2,000 pounds (lbs); Metric ton = 2,204 lbs.
(b) ** Waste management unit costs from HWIR Cost-Benefit Assessment, Exhibit 3-2, p.3-5, 25 May 1995 (derived from LDR study).
For purpose of preliminary estimation, national average unit costs for waste treatment, rather than regional- and facility/process-specific costs are applied above.
In absence of readily-available reference data, land application unit cost applied above, roughly-estimated as 25% of unit cost for landfilling waste (i.e. 25% x $50/ton).
(c) *** Incineration ash reportedly ranges from 10% to 30% of sludge weight; midpoint of this range applied in computation above = 20%
(d) **** 1995-based incremental cost updated from 1995$ to 1998$ with the ENR Cost Index multiplier= 1.082
(e) Incremental costs in section C above rounded to nearest thousand dollars.
(f) +/- Uncertainty range applied to point estimate (to reflect underlying data and computation uncertainty) = 25%
(g) Waste management unit costs inclusive of average distance off-site transportation costs.
(h) Waste management costs common to both ex-ante & ex-post (if equal tons) not required for incremental analysis.
(i) Net profit rate of chemical sales revenue applied above based on 1992-98 national median for SIC codes 281,282,286 = 5.4%
(j) Ex-ante financial impact analysis above is illustrative only, based on EMRAD estimates rather than CBI data; actual ex-post profit impact to affected facilities depends on market structure and price elasticity of demand.
(k) EMRAD estimated the annual quantity of actual final VCM production for the single facility (Georgia Gulf) using land application, by multiplying the 1,600 million pounds (800,000 tons) reported annual VCM capacity (www.chemexpo.com) for this facility, by the 1990-97 86.1% capacity utilization rate for SIC codes 282 & 286.
(l) US average VCM market price (in $/pound, April 1999) quoted from "ChemExpo" http://www.chemexpo.com/news/PROFILE980216.cfm
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EXHIBIT C-6

CHLORINATED ALIPHATIC RCRA-LISTING PROPOSAL
FACILITY COMPLIANCE COST FOR THE VCM-A PROCESS (ONE FACILITY):
PRELIMINARY ESTIMATE (BASED ON NON-CBI INFORMATION)

Waste volumes from VCM-A process (non-CBI)>>>

Waste type	metric tons/yr	short* tons/yr
SLUDGE=	120	132
WWATER=	22,200	24,464

				(tons/yr)	Unit cost ($/ton)**	Average annual cost/impact
A.	**EX ANTE WASTE MANAGEMENT (INTIALLY ASSUMED CURRENT 3-STEP TRAIN):**					
A1	SLUDGE	Primary sedimentation		132		
A2	SLUDGE	Lined landfill		132	$130	$17,190
A3	WWATER	Preliminary/Primary/Secondary Treatment		24,464		
A4	WWATER	Discharge to POTW under NPDES permit		24,464		
A5			Total cost A=			$17,190
B.	**EX POST WASTE MANAGEMENT (IF RCRA-LISTED WITH ASSUMED 5-STEP TRAIN):**					
B1	SLUDGE	Primary sedimentation		132		
B2	SLUDGE	Retorting of sludge to extract mercury***		132	$1,284	$169,800
B3	SLUDGE	Disposal retorted sludge in Subtitle C haz landfill***	(if 99%)	131	$195	$25,530
B4	WWATER	Preliminary/Primary/Secondary Treatment		24,464		
B5	WWATER	Discharge to POTW under NPDES permit		24,464		
B6			Total cost B=			$195,330
C.	**INCREMENTAL FACILITY COST OF RCRA LISTING (B-A):**					
C1		Incremental cost (1995$) to VCM-A producing facility (B7-A5)=				$178,000
C2		Incremental cost updated to 1998$****=				**$193,000**
C3		Cost range with +/-10% estimation uncertainty applied =			**$174,000**	**$212,000**
D.	**FINANCIAL IMPACT OF INCREMENTAL COST ON FACILITY:**					
D1		1998 US average unit value (sale price) of VCM product ($/lb)=				$0.2175
D2		Estimated annual quantity VCM-A product sales from facility (tons++)=				137,760
D3		Estimated annual sales revenue from VCM-A sales (D1 x 2000 x D2)=				$59,925,600
D4		Incremental cost as percent of annual VCM-A sales revenues (C2/D3)=				0.3%
D5		Estimated annual net profit from VCM-A sales (D3 x 7.1% net profit rate)=				$4,375,000
D6		Incremental cost as percent of annual net sales profit (C2/D5)=				**4%**
D7		Net profit comparison range with +/-10% uncertainty (C3/D5)=			**4%**	**5%**

Explanatory Notes: OSW-EMRAD (Econ)

(a) * Short ton = 2,000 pounds (lbs); Metric ton = 2,204 lbs.
Waste volumes provided to EMRAD-Econ 09/28/98 by Ann Johnson (USEPA-OSWER-OSW-EMRAD).
(b) ** Waste management unit costs from HWIR Cost-Benefit Assessment, Exhbt 3-2, p.3-5, 25 May 1995.
National average costs rather than regional- and facility/process-specific costs are applied above.
(c) *** Because of initial uncertainty of commercial availability, a unit cost premium multiplier is applied to mercury retorting and to hazardous landfilling requiring two restrictions (low pH and no sulfides) = 1.5
(d) **** 1995-based incremental cost updated from 1995$ to 1998$ with the ENR Cost Index multiplier= 1.082
(However, US environmental project costs in mid-1990s have been declining in some applications.)
(e) Incremental costs in section C above rounded to nearest thousand dollars.
(f) Waste management unit costs inclusive of average distance off-site transportation costs.
(g) Waste management costs common to both ex-ante & ex-post (if equal tons) not required for incremental analysis.
(h) +/-10% applied to incremental cost estimate to provide an illustrative uncertainty bound to account for possible variability in underlying computation parameters and facility VCM-A process operations.
(i) ++Annual sales quantity above (item D2) estimated by OSW-EMRAD by applying 86.1% national average capacity utilization, to Borden's 1998 reported installed annual VCM-A capacity of 320 million pounds (160,000 tons); from www.chemexpo.com.
(j) Net profit rate from industrial chemical sales revenue per 1995-98 average for SIC codes 281+282+286= 7.3%
(k) Financial impact analysis above is illustrative only, based on EMRAD estimates rather than CBI data; actual ex-post profit impact to the VCM-A producer depends on market structure and price elasticity of demand.
(l) F:\USER\MEADS\PROJECTS\CHLORALP\ECONWORK\VCMACOST.WK4 OSW-EMRAD 07/29/99

ATTACHMENT D:

ESTIMATED SUBTOTAL INDUSTRY COMPLIANCE COSTS FOR THE WASTEWATER CATEGORY (WASTECODE K173) OF THIS RCRA LISTING PROPOSAL

EXHIBIT D-1

1997 SECTION 3007 SURVEY MASKED DATA: CAHC MFG. WASTEWATER TANK SIZES BASED ON 15 FACILITIES SUPPLYING DATA

Facility Data item	Nr. of CAHC mfg. wastestreams	Facility nr. of tanks	Total capacity (gallons)	Mean gallons per tank
1	7	4	180,000	45,000
2	5	2	90,000	45,000
3	3	1	55,000	55,000
4	4	1	55,000	55,000
5	7	3	165,000	55,000
6	3	1	55,000	55,000
7	5	1	55,000	55,000
8	8	7	700,000	100,000
9	8	9	2,970,000	330,000
10	5	7	3,262,000	466,000
11	5	5	2,705,000	541,000
12	3	1	550,000	550,000
13	5	1	550,000	550,000
14	10	13	9,100,000	700,000
15	4	2	1,550,000	775,000
Totals=	82	**58**	**22,042,000**	

EXHIBIT D-2

USEPA RCRA LISTING PROPOSAL FOR CHLORINATED ALIPHATIC MANUFACTURING FACILITIES
SUMMARY OF 1997 SECTION 3007 CAHC MANUFACTURING INDUSTRY MASKED SURVEY DATA
INDUSTRY COMPLIANCE WITH WASTEWATER LISTING OPTION

WASTEWATER TANK SIZE CLASSES

A	B	C	D	E	F	G	H	I	J	K	L	M
A. 1997 SECTION 3007 SURVEY TANK DATA:							**B. EXTRAPOLATION TO 23 CAHC MFG FACILITIES:**					
							B1. Tank Universe:			**B2. Non-Compliant Tanks:**		
Tank size class	Mean waste tank size (gallons)	Nr. of survey reported tanks	Survey tank size class distribution	Nr. of CAHC mfg. waste streams	Nr. of tanks without covers	% of tanks without covers	Imputed total nr. of tanks	Imputed nr. tanks without covers	Imputed nr. of waste streams	Estimated* nr. waste streams >threshold	Estimated* nr. tanks >threshold	Estimated* nr. tanks >threshold w/out covers
1	45,000	6	10%	12	4	67%	9	6	13	2	2	1
2	55,000	7	12%	22	7	100%	11	11	15	3	2	2
3	100,000	7	12%	8	7	100%	11	11	15	3	2	2
4	330,000	9	16%	8	0	0%	14	0	20	3	2	0
5	466,000	7	12%	5	7	100%	11	11	15	3	2	2
6	541,000	5	9%	5	0	0%	8	0	11	2	1	0
7	550,000	2	3%	8	1	50%	3	2	4	1	1	0
8	700,000	13	22%	10	5	38%	20	8	28	5	3	1
9	775,000	2	3%	4	2	100%	3	3	4	1	1	1
C. COLUMN SUMMARIES:												
Column totals=		58	100%	82	33	57%	**90**	51	125	21	**15**	9
Nr. of facilities=		15					**23**					

D. EXPLANATORY NOTES:

(a) * If dioxin concentration failure rate is based on the six wastestream samples applied in the risk analysis= **17%**
The six samples represent "dedicated" wastestreams only; not necessarily representative of "comingled" wastestreams.

(b) Note: The 1997 Section 3007 survey contains CBI tank data; statistics above aggregated to mask individual CBI responses.
For additional CBI protection, tank size classes shown above are not based on actual survey-reported sizes,
but are mean sizes derived by OSW-EMRAD from aggregate tank capacities.

EXHIBIT D-3

USEPA'S 1999 CHLORINATED ALIPHATIC LISTING PROPOSAL 05/05/99
RCRA "SUBPART CC" AIR EMISSION STANDARDS FOR TANKS (06 DEC 1994*)

Tank system control options	Tank system listing cost element	Tank System Engineering Controls* (per Dec 1994 Final Rule for RCRA air emission standards for TSD and generator tanks)	"Subpart CC" 40 CFR reference part & section
A. TANK AIR EMISSIONS RCRA COVER OPTIONS:			
A1	**Standard Option #1 (264.1084(b)(1)):**		
	A1a	Fixed roof	264.1084(d)(1)
	A1b	Closed-vent system (organic vapors)	264.1087(b)
	1	May have one or more bypass devices	
	2	Must have flow indicator for each bypass device	
	3	Bypass device inlet valve (seal or lock type)	
	A1c	Control device (for vent system):	264.1087(c)
	1	Thermal vapor incinerator	
	2	Flare	
	3	Boiler	
	4	Process heater	
	5	Condenser	
	6	Carbon adsorption	
	7	Other device as demonstrated	
A2	**Alternative Option #2 (264.1084(b)(2)):**		265.1091(a)(1)
	A2a	Fixed cover	265.1085(d)(1)
	A2b	Internal floating roof	265.1091(a)(1)(ii)
	A2c	Internal floating roof closure seals and gaskets	265.1091(a)(1)(ii)
A3	**Alternative Option #3 (264.1084(b)(3)):**		265.1091(a)(2)
	A3a	External floating roof	
	A3b	External floating roof - primary seal	
	A3c	External floating roof - scondary seal	
A4	**Alternative Option #4 (264.1084(b)(4)):**		
	A4a	Pressure tank (closed system)	
B. OTHER TANK AIR EMISSIONS RCRA ENGINEERING CONTROLS:			
B1	Enclosed pipe drain system for tank		264.1084(e)
B2	Gasketed lids or caps on all tank cover openings		264.1084(f)
B3	Safety devices		264.1084(g)
C. TANK AIR EMISSIONS RCRA "SUBPART CC" ANCILLARY REQUIREMENTS:			
C1	**Control device performance demonstration:**		264.1087(c)(5)
		Performance test method, or performance design analysis	
C2	**Inspection & monitoring:**		264.1088
	C2-1	Option #1:	
		Prepare written tank control inspection plan and schedule	264.1088(e)
		Visually inspect cover at least every 6 months	265.1089(f)
		Monitor cover for detectable organic emissions every 6 months	265.1089(f)
	C2-2	Option #2:	265.1091(b)(1)
		Prepare written tank control inspection plan and schedule	264.1088(e)
		Visually inspect internal roof at least annually	
	C2-3	Option #3:	265.1091(b)(2)
		Prepare written tank control inspection plan and schedule	264.1088(e)
		Measure seal gaps at least every 5 years	
	C2-4	Option #4:	
		Prepare written tank control inspection plan and schedule	264.1088(e)
C3	**Recordkeeping:**		264.1089
	C3-1	Option #1:	264.1089
		Tank control equipment descriptive documentation	
		Design analysis or test plan and results	
		Inspection & monitoring record	
	C3-2	Option #2:	265.1091(c)(1)
		Tank control equipment descriptive documentation	
		Design analysis or test plan and results	
		Roof inspection record	
	C3-3	Option #3:	265.1091(c)(2)
		Tank control equipment descriptive documentation	
		Design analysis or test plan and results	
		Gap inspection record	
	C3-4	Option #4:	
		Tank control equipment descriptive documentation	
C4	**Reporting:**		264.1090
	C4a	Report noncompliance occurrences to USEPA regional office	
	C4b	Submit semiannual written report to USEPA regional office	

D. REFERENCES:

(a) * USEPA "Final Rule: Hazardous Waste Treatment, Storage, and Disposal Facilities and Hazardous Waste Generators: Organic Air Emission Standards for Tanks, Surface Impoundments, and Containers", Federal Register, Vol.59, Nr.233, 06 Dec 1994, p.62896. This final rule established the new "Subpart CC" of 40 CFR 264&265, effective 05 June 1995.

EXHIBIT D-4

FIXED ROOF ON OPEN TANK
WITH STAINLESS STEEL PRESSURE RELIEF VALVE

CHLORINATED ALIPHATIC MANUFACTURING WASTE TANKS
CAPITAL COST FOR TANK ROOF & VALVE PURCHASE & INSTALLATION ($ PER TANK)
SCALED ACCORDING TO ALTERNATIVE TANK SIZES

	Tank size class row item	A Waste tank size (gallons)	B Tank height* (feet)	C Tank radius* (feet)	D Tank Volume* (cu.ft)	E Roof area** (if flat) (sq.feet)	F Roof capital cost*** ($1986)	G Roof cost updated to $1999****	H Sales tax & shipment cost if 8% of roof cost	I Field installation cost if 20% of roof cost	J Total capital cost $1999 (G+H+I)	K Annual O&M cost (1999$)	L O&M as % of capital cost
Reference>	0	20,000	9.1	9.7	2,674	293	$11,440	$16,295	$1,304	$3,259	**$20,857**	**$1,567**	8%
	1	45,000	12.0	12.6	6,016	502	$19,642	$27,978	$2,238	$5,596	**$35,812**	**$2,690**	8%
	2	55,000	12.8	13.5	7,353	574	$22,454	$31,983	$2,559	$6,397	**$40,938**	**$3,075**	8%
	3	100,000	15.6	16.5	13,369	855	$33,450	$47,645	$3,812	$9,529	**$60,986**	**$4,581**	8%
	4	330,000	23.3	24.6	44,118	1,896	$74,142	$105,606	$8,449	$21,121	**$135,176**	**$10,154**	8%
	5	466,000	26.1	27.6	62,299	2,388	$93,379	$133,006	$10,640	$26,601	**$170,247**	**$12,789**	8%
	6	541,000	27.4	29.0	72,326	2,636	$103,083	$146,829	$11,746	$29,366	**$187,941**	**$14,118**	8%
	7	550,000	27.6	29.1	73,529	2,665	$104,223	$148,453	$11,876	$29,691	**$190,019**	**$14,274**	8%
	8	700,000	30.9	32.7	93,583	3,350	$130,997	$186,588	$14,927	$37,318	**$238,832**	**$17,941**	8%
	9	775,000	32.6	34.5	103,610	3,728	$145,798	$207,671	$16,614	$41,534	**$265,818**	**$19,968**	8%

Explanatory Notes:

(a) Unit cost data source (row item #0): USEPA Office of Air & Radiation, "Hazardous Waste TSDF - Background Information for Proposed RCRA Air Emission Standards: Vol.III: Appendices G-L", report nr. EPA-450/3-89-023c, June 1991.

(b) * Tank height-to-diameter ratio (9 feet:to:19 feet) maintained for >20,000 gallon sizes (ratio from the reference document).

(c) ** Tank roof area computed using 3.1415927*[(radius)^2].

(d) *** Roof costs estimated for sizes >20,000 proportionally to roof area; annual O&M costs proportioned to capital cost.

(e) Annual O&M costs include utilities, maintenance labor & materials, overhead, taxes, insurance & admin. costs.

(f) **** Cost update multiplier formulated from ENR Construction Cost index:

1986= 4218 (January index)

1999= 6008 (April 1999 index) Multiplier= 1.424

(g) Conversion: 1.0 gallon = 0.1337 cubic feet; 1.0 cubic foot = 7.48 gallons.

(h) F:\USER\MEADS\PROJECTS\CHLORALP\ECONWORK\TANKCOST.WK4 OSW-EMRAD 07/29/99

EXHIBIT D-5

TANK VENT CARBON CANISTER CONTROL DEVICE W/FLAME ARRESTOR AND PIPING FOR COVERED OR FIXED ROOF TANK

CHLORINATED ALIPHATIC MANUFACTURING WASTE TANKS

CAPITAL COST FOR CANISTER, ARRESTOR & PIPING PURCHASE & INSTALLATION ($ PER TANK)

SCALED ACCORDING TO ALTERNATIVE TANK SIZES

	Tank size class row item	A Waste tank size (gallons)	B Tank height* (feet)	C Tank radius* (feet)	D Tank Volume* (cu.ft)	E Roof area** (if flat) (sq.feet)	F Canister capital cost*** ($1986)	G Canister cost up-dated to $1999****	H Sales tax & shipment cost if 8% of canstr cost	I Field installation cost if 20% of canstr cost	J Total capital cost (G+H+I)	K Annual O&M cost (1999$)	L O&M as % of capital cost
Reference>	0	20,000	9.1	9.7	2,674	293	$1,590	$2,265	$181	$453	**$2,899**	**$11,366**	392%
	1	45,000	12.0	12.6	6,016	502	$2,730	$3,889	$311	$778	**$4,977**	**$19,516**	392%
	2	55,000	12.8	13.5	7,353	574	$3,121	$4,445	$356	$889	**$5,690**	**$22,310**	392%
	3	100,000	15.6	16.5	13,369	855	$4,649	$6,622	$530	$1,324	**$8,476**	**$33,235**	392%
	4	330,000	23.3	24.6	44,118	1,896	$10,305	$14,678	$1,174	$2,936	**$18,788**	**$73,666**	392%
	5	466,000	26.1	27.6	62,299	2,388	$12,978	$18,486	$1,479	$3,697	**$23,662**	**$92,779**	392%
	6	541,000	27.4	29.0	72,326	2,636	$14,327	$20,407	$1,633	$4,081	**$26,121**	**$102,421**	392%
	7	550,000	27.6	29.1	73,529	2,665	$14,486	$20,633	$1,651	$4,127	**$26,410**	**$103,554**	392%
	8	700,000	30.9	32.7	93,583	3,350	$18,207	$25,933	$2,075	$5,187	**$33,194**	**$130,155**	392%
	9	775,000	32.6	34.5	103,610	3,728	$20,264	$28,863	$2,309	$5,773	**$36,945**	**$144,861**	392%

Explanatory Notes:

(a) Unit cost data source (row item #0): USEPA Office of Air & Radiation, "Hazardous Waste TSDF - Background Information for Proposed RCRA Air Emission Standards: Vol.III: Appendices G-L", report nr. EPA-450/3-89-023c, June 1991.

(b) * Tank height-to-diameter ratio (i.e. 9 feet:to:19 feet) maintained for >20,000 gallon sizes (ratio from the reference document).

(c) ** Tank roof area computed using 3.1415927*[(radius)^2].

(d) *** Roof costs estimated for sizes >20,000 proportionally to roof area; annual O&M costs proportioned to capital cost.

(e) Annual O&M costs include utilities, maintenance labor & materials, overhead, taxes, insurance & admin. costs.

(f) **** Cost update multiplier formulated from ENR Construction Cost index:
1986= 4218 (January index)
1999= 6008 (April 1999 index) Multiplier= $\boxed{1.424}$

(g) Conversion: 1.0 gallon = 0.1337 cubic feet; 1.0 cubic foot = 7.48 gallons.

(h) Reference document assumes two carbon canisters required for reference size tank of 20,000 gallons.

(i) Reference document annual cost for replacement of carbon canisters used for aqueous sludge/slurry type waste.
Reference document assumes an average annual rate of 8 canisters replaced per tank at the 20,000 reference size level.

EXHIBIT D-6

USEPA'S 1999 CHLORINATED ALIPHATIC LISTING PROPOSAL
UNIT COSTS APPLIED FOR ESTIMATION OF RCRA LISTING COMPLIANCE COSTS FOR WASTEWATER TANKS

Tank system control options	Tank system listing cost element	**Tank System Engineering Controls*** (per Dec 1994 Final Rule for RCRA air emission standards for TSD and generator tanks)	"Subpart CC" 40 CFR reference part & section	National average annual cost per facility ($1997)	Unit cost data source year	Facility annual cost updated to $1999	Unit cost source	Number of Annual Hours Legal	Mngrl	Technd	Clerical
C. TANK AIR EMISSIONS RCRA "SUBPART CC" ANCILLARY REQUIREMENTS:											
C1	**Control device performance demonstration:**		264.1087(c)(5)								
		Performance test method, or performance design analysis		$2,298	1997		(a)	0.0	0.0	2.0	0.1
C2	**Inspection & monitoring:**		264.1088								
	C2-1	Option#1:									
		Prepare written tank control inspection plan and schedule	264.1088(e)	$290	1997		(a)	0.0	0.0	6.0	0.1
		Visually inspect cover at least every 6 months	265.1089(f)	$2,688	1997		(a)*2	0.0	0.0	28.0	0.0
		Monitor cover for detectable organic emissions every 6 months	265.1089(f)	$2,688	1997		(a)*2	0.0	0.0	28.0	0.0
	C2-2	Option#2:	265.1091(b)(1)								
		Prepare written tank control inspection plan and schedule	264.1088(e)	$290	1997		(a)	0.0	0.0	6.0	0.1
		Visually inspect internal roof at least annually		$1,344	1997		(a)	0.0	0.0	28.0	0.0
	C2-3	Option#3:	265.1091(b)(2)								
		Prepare written tank control inspection plan and schedule	264.1088(e)	$290	1997		(a)	0.0	0.0	6.0	0.1
		Measure seal gaps at least every 5 years		$269	1997		(a)/5	0.0	0.0	5.6	0.0
	C2-4	Option#4:									
		Prepare written tank control inspection plan and schedule	264.1088(e)	$290	1997		(a)	0.0	0.0	6.0	0.1
C3	**Recordkeeping:**		264.1089								
	C3-1	Option#1:	264.1089								
		Tank control equipment descriptive documentation		$279	1997		(a)	0.0	0.0	5.5	0.6
		Design analysis or test plan and results		$290	1997		(a)	0.0	0.0	6.0	0.1
		Inspection & monitoring record		$98	1997		(a)	0.0	0.0	2.0	0.1
	C3-2	Option#2:	265.1091(c)(1)								
		Tank control equipment descriptive documentation		$279	1997		(a)	0.0	0.0	5.5	0.6
		Design analysis or test plan and results		$290	1997		(a)	0.0	0.0	6.0	0.1
		Roof inspection record		$98	1997		(a)	0.0	0.0	2.0	0.1
	C3-3	Option#3:	265.1091(c)(2)								
		Tank control equipment descriptive documentation		$279	1997		(a)	0.0	0.0	5.5	0.6
		Design analysis or test plan and results		$290	1997			0.0	0.0	6.0	0.1
		Gap inspection record		$98	1997		(a)	0.0	0.0	2.0	0.1
	C3-4	Option#4:									
		Tank control equipment descriptive documentation		$279	1997		(a)	0.0	0.0	5.5	0.6
C4	**Reporting:**		264.1090								
	C4a	Report noncompliance occurrences to USEPA regional office		$290	1997		(a)	0.0	0.0	6.0	0.1
	C4b	Submit semiannual written report to USEPA regional office		$453	1997		(a)*2	0.3	0.4	6.0	4.1
SUBTOTAL COST C:											
		Standard Reg. Option#1 (40 CFR 264.1084(b)(1))		$9,376		$10,339		0.3	0.4	89.5	5.2
		Alternative Reg. Option#2 (40 CFR 264.1084(b)(2))		$5,344		$5,890		0.3	0.4	61.5	5.2
		Alternative Reg. Option#3 (40 CFR 264.1084(b)(3))		$3,891		$4,154		75.0	75.0	108.1	76.1
		Alternative Reg. Option#4 (40 CFR 264.1084(b)(4))		$3,612		$3,970		0.3	0.4	25.5	5.0

D. REFERENCES:

(a) * USEPA "Final Rule: Hazardous Waste Treatment, Storage, and Disposal Facilities and Hazardous Waste Generators; Organic Air Emission Standards for Tanks, Surface Impoundments, and Containers", Fed.Reg., Vol.59, Nr.233, 06 Dec 1994, p.62896. (This final rule established the new "Subpart CC" of 40 CFR 264 & 265, effective 05 June 1995.)

(b) Ancillary cost data source: USEPA Information Collection Request (ICR) Nr. 0820.06, "Hazardous Waste Generator Standards", 19 Nov 1997, pp.58, 60.

(c) Engineering control unit cost data source: USEPA Office of Air & Radiation, "Hazardous Waste TSDF - Background Information for Proposed RCRA Air Emission Standards: Vol.III: Appendices G-L", report nr. EPA-450/3-89-023c, June 1991.

(d) Annual "Ancillary Requirements" price level update factor:

Average Hourly Labor Rates by Labor Category**:

	Legal	Mngrl	Technd	Clerical
1999>>	$102.00	$73.32	$53.00	$27.00
1997>>	$93.48	$73.32	$47.99	$25.10
Ratio 99/97>>	1.091	1.000	1.104	1.076

(e) ** 1999 labor rates from USEPA ICR Nr.801 (RCRA Hazardous Waste Manifest System), 23 March 1999.

EXHIBIT D-7

TANK RELATED COSTS FOR WASTEWATER LISTING K17

USEPA RCRA LISTING PROPOSAL: CHLORINATED ALIPHATIC MANUFACTURING INDUSTRY

TANK COVER + VENT/CONTROL + ANCILLARY COSTS

			A	B	C	D	E	F	G
			A. Tank Cover (#1):**		**B. Tank Vent+Control:**		**C. Ancil-lary costs for Sub-part "CC"**	**D. Total Tank Costs:**	
Tank row item count	Tank size class	Mean waste tank size (gallons)	Fixed roof+valve costs ($lumpsum)	Annual roof+valve O&M cost ($/year)	Carbon device w/piping ($lumpsum)	Carbon replacement & disposal ($/year)	($/year)	Initial cost (A+C) ($lumpsum)	Annual costs (B+D+E) ($/year)
A. IMPUTED TANK SIZES:									
1	1	45,000	$35,800	$2,700	$5,000	$19,500	$2,632	$40,800	$24,832
2	2	55,000	$40,900	$3,100	$5,700	$22,300	$2,632	$46,600	$28,032
3		55,000	$40,900	$3,100	$5,700	$22,300	$2,632	$46,600	$28,032
4	3	100,000	$61,000	$4,600	$8,500	$33,200	$2,632	$69,500	$40,432
5		100,000	$61,000	$4,600	$8,500	$33,200	$2,632	$69,500	$40,432
6	5	466,000	$170,200	$12,800	$23,700	$92,800	$2,632	$193,900	$108,232
7		466,000	$170,200	$12,800	$23,700	$92,800	$2,632	$193,900	$108,232
8	8	700,000	$238,800	$17,900	$33,200	$130,200	$2,632	$272,000	$150,732
9	9	775,000	$265,800	$20,000	$36,900	$144,900	$2,632	$302,700	$167,532
B. SUMMARY STATISTICS:									
B1	Column Totals=		$1,084,600	$81,600	$150,900	$591,200	$23,690	**$1,236,000**	**$696,000**
	-10% cost estimation uncertainty**** =							**$1,112,400**	**$626,400**
	+30% cost estimation uncertainty**** =							**$1,606,800**	**$904,800**
B2	Average per tank =		$120,511	$9,067	$16,767	$65,689	$2,632	$137,333	$77,333

C. EXPLANATORY NOTES:

(a) * Source: Based on midpoints of responses to Section 3007 survey questionnaire tank size ranges.

(b) ** Tank roof+valve costs represent tank cover option #1 of RCRA "Subpart CC" tank standards 40 CFR 264.1084(b)(1).

(c) Not incrmntl = Not incremental to baseline because tanks already covered according to 1997 Section 3007 survey.

(d) *** Ancillary costs (recordkeeping, etc.) per facility divided by average number of tanks, to express on per tank basis, according to the mean number of wastewater tanks, per relevant CAHC mfg facility = 3.9

(e) **** Cost estimation uncertainty adopted from Assoc for Advancement of Cost Engineering RPN 18R-97, 1998.

(f) Carbon C-landfill unit cost included above based on price-updated reference for single canister= $103

(g) F:\USER\MEADS\PROJECTS\CHLORALP\ECONWORK\TANKCOST.WK4 OSW-EMRAD 07/29/99

EXHIBIT D-8

USEPA RCRA LISTING PROPOSAL: CHLORINATED ALIPHATIC MANUFACTURING INDUSTRY
INDUSTRY COMPLIANCE WITH WASTEWATER LISTING OPTION K173

ESTIMATED WASTE TESTING COSTS

Row item	Tank Wastewater Dioxin Testing Cost Estimation Parameter		Number of Dioxin Tests: Initial waste testing	Number of Dioxin Tests: Annual* waste retesting
A	Total number of CAHC mfg industry wastewater treatment/storage tanks=	90		
B	Subtotal number of tanks currently without air emission covers=	51	51	
C	Assumed percentage of waste tanks exceeding dioxin threshold**=	17%		
D	Number of waste tanks exceeding dioxin threshold and requiring covers=	9		
E	Number of uncovered tanks meeting dioxin threshold (not requiring covers)=	43		43
F	Estimated initial dioxin testing cost (lumpsum $ in POA base year) =		**$84,500**	
G	Estimated average annual dioxin retesting cost ($/year) =			**$70,400**
	-25% cost estimation uncertainty =		$63,375	$52,800
	+25% cost estimation uncertainty =		$105,625	$88,000

Explanatory Notes:

(a) * Annual testing frequency applied, per RCRA "Subpart CC" air emission VOC testing requirements as specified at 40 CFR 264.1084; however, process/batch changes trigger higher annual retesting frequencies. For the purpose of accounting for such possibility, the following annual frequency multiplier factor, as a placeholder assumption, is applied in this study (public encouraged to provide comment) = **1.1**

(b) ** Percentage shown based only on six samples from different "dedicated" CAHC mfg wastestreams (as presented in the risk analysis for this listing proposal), and are not necessarily representative of "comingled" CAHC mfg. wastestreams.

(c) Average unit cost ($ per waste sample) for dioxin testing applied in this study= **$1,500**

EXHIBIT D-9

USEPA 1999 RCRA LISTING PROPOSAL:
CHLORINATED ALIPHATIC MANUFACTURING INDUSTRY
INDUSTRY COMPLIANCE WITH WASTEWATER LISTING OPTION K173

SUMMARY OF TANK COSTS

Item	Type of Tank Cost Element	Initial costs ($lumpsum)	Annual costs ($/year)
A	Tank roof + valve	$1,084,600	$81,600
B	Tank vent + control device	$150,900	$591,200
C	Ancillary "Subpart CC" tank costs	$0	$23,690
D	Tank waste dioxin testing	$84,500	$70,400
E	Total tank-related costs (A+..+D)	**$1,320,000**	**$766,890**
	-10% cost estimation uncertainty* =	$1,188,000	$690,201
	+30% cost estimation uncertainty* =	$1,716,000	$996,957

Explanatory Notes:

(a) Refer to supplementary companion worksheets for itemized cost computations.

(b) * +/-% uncertainty from Assoc. Advancement of Cost Engineering RPN 18R-97, 1998.

(c) F:\USER\MEADS\PROJECTS\CHLORALP\ECONWORK\TANKCOST.WK4

ATTACHMENT E:

ESTIMATED TOTAL INDUSTRY COMPLIANCE COSTS FOR BOTH THE SLUDGE PLUS WASTEWATER CATEGORIES OF THIS RCRA LISTING PROPOSAL

EXHIBIT E-1

1999 PROPOSED LISTING REQUIREMENTS

CHLORINATED ALIPHATIC HYDROCARBON COMPOUNDS (CAHCs)
SUMMARY OF ESTIMATED INDUSTRY COMPLIANCE COSTS FOR THE RCRA LISTING PROPOSAL
WASTEWATER TREATMENT SLUDGES AND WASTEWATERS

AVERAGE ANNUAL EQUIVALENT TOTAL INDUSTRY COST

Item	Type of CAHC Facility Potentially Affected by the Proposed RCRA Listing Options	Nr. of affected CAHC mfg. facilities	Nr. of affected CAHC mfg. processes	Initial capital costs ($ lump-sum)	Recurring annual O&M costs ($/year)	Average annualized equivalent total cost	Discounted present value total cost
A. SLUDGE LISTING ESTIMATED COSTS:							
A1	Non-landfilled EDC/VCM sludge	1	1	$0	$1,333,000		
A2	VCM-A process w /mercury catalyst	1	1	$0	$209,000		
	Subtotal sludge costs=	2	2	$0	$1,542,000		
B. WASTEWATER LISTING ESTIMATED COSTS:							
B1	Tank fixed roof + valve		9 tanks	$1,084,600	$81,600		
B2	Tank roof vent + carbon control device		9 tanks	$150,900	$591,200		
B3	Tank "Subpart CC" ancillary costs*		9 tanks	$0	$23,700		
B4	Initial w aste testing for dioxins		51 tanks	$84,500	$0		
B5	Annual w aste retesting for dioxins		43 tanks	$0	$70,400		
	Subtotal w astew ater costs=			$1,320,000	$766,900		
C. SLUDGE + WASEWATER COSTS (column totals):				**$1,320,000**	**$2,309,000**		
	w ith -25% estimation uncertainty =			$990,000	$1,731,750		
	w ith +25% estimation uncertainty =			$1,650,000	$2,886,250		
D. AVERAGE ANNUAL EQUIVALENT (AAE) TOTAL COST (at alternative discount rates):							
	0.0%			$46,000		**$2,355,000**	$68,295,000
	3.0%			$69,000		$2,378,000	$45,630,000
	5.0%			$87,000		$2,396,000	$36,278,000
	7.0%			$108,000		**$2,417,000**	$29,675,000
	10.0%			$141,000		$2,450,000	$22,956,000

E. EXPLANATORY NOTES:

(a) * "Subpart CC" ancillary costs consist of recordkeeping, reporting, etc. (general RCRA administrative burden costs not included above).

(b) Average annualized equivalent (AAE) computed by amortizing initial capital cost assumed to occur in the base-year, over the period-of-analysis (POA) number of years, minus one year = 29
The average annualized equivalent (AAE) capital cost, is added to the future average annual O&M cost, to derive a discounted future annual total cost (refer to next w orksheet).

EXHIBIT E-2

US CAHC PRODUCTION (HISTORICAL TREND 1970-1996 AND FUTURE SCENARIO#2)

			A. CAHC SOLVENTS				B. PLASTIC PRECURSORS				C. TOTAL DATA (A+B)			
Row item	30-yr POA	Year	(mill.lbs)	%delta	Regression line values	%delta	(mill.lbs)	%delta	Regression line values	%delta	(mill.lbs)	%delta	Regression line values	%delta
0		1970	1,772		1,762		11,500		6,000		13,272		7,763	
1		1980	2,044		1,888		17,574		15,956		19,618		17,843	
2		1981	2,093	2.4%	1,900	0.66%	16,848	-4.1%	16,951	6.24%	18,941	-3.5%	18,851	5.65%
3		1982	1,782	-14.9%	1,913	0.66%	12,521	-25.7%	17,947	5.87%	14,303	-24.5%	19,859	5.35%
4		1983	1,902	6.7%	1,925	0.66%	18,381	46.8%	18,942	5.55%	20,283	41.8%	20,867	5.08%
5		1984	2,067	8.7%	1,938	0.65%	16,795	-8.6%	19,938	5.26%	18,862	-7.0%	21,875	4.83%
6		1985	1,835	-11.2%	1,950	0.65%	21,564	28.4%	20,933	4.99%	23,399	24.1%	22,883	4.61%
7		1986	2,007	9.4%	1,963	0.64%	21,379	-0.9%	21,929	4.76%	23,386	-0.1%	23,892	4.41%
8		1987	1,824	-9.1%	1,975	0.64%	20,599	-3.6%	22,924	4.54%	22,423	-4.1%	24,900	4.22%
9		1988	1,954	7.1%	1,988	0.63%	22,086	7.2%	23,920	4.34%	24,040	7.2%	25,908	4.05%
10		1989	2,012	3.0%	2,001	0.63%	23,518	6.5%	24,915	4.16%	25,530	6.2%	26,916	3.89%
11		1990	1,815	-9.8%	2,013	0.63%	24,474	4.1%	25,911	4.00%	26,289	3.0%	27,924	3.75%
12		1991	1,560	-14.0%	2,026	0.62%	25,615	4.7%	26,906	3.84%	27,175	3.4%	28,932	3.61%
13		1992	2,088	33.8%	2,038	0.62%	26,457	3.3%	27,902	3.70%	28,545	5.0%	29,940	3.48%
14		1993	2,154	3.2%	2,051	0.62%	32,167	21.6%	28,897	3.57%	34,321	20.2%	30,948	3.37%
15		1994	2,153	-0.0%	2,063	0.61%	33,517	4.2%	29,893	3.45%	35,670	3.9%	31,956	3.26%
16		1995	2,221	3.2%	2,076	0.61%	32,240	-3.8%	30,888	3.33%	34,461	-3.4%	32,964	3.15%
17		1996	2,275	2.4%	2,088	0.60%	35,400	9.8%	31,884	3.22%	37,675	9.3%	33,972	3.06%
18		1997			2,101	0.60%			32,879	3.12%			34,980	2.97%
19		1998			2,113	0.60%			33,875	3.03%			35,988	2.88%
20		1999			2,126	0.59%			34,870	2.94%			36,996	2.80%
21		2000			2,138	0.59%			35,866	2.85%			38,004	2.72%
BASE> 22	1	2001			2,151	0.59%			36,861	2.78%			39,013	2.65%
23	2	2002			2,164	0.58%			37,857	2.70%			40,021	2.58%
24	3	2003			2,176	0.58%			38,853	2.63%			41,029	2.52%
25	4	2004			2,189	0.58%			39,848	2.56%			42,037	2.46%
26	5	2005			2,201	0.57%			40,844	2.50%			43,045	2.40%
27	6	2006			2,214	0.57%			41,839	2.44%			44,053	2.34%
28	7	2007			2,226	0.57%			42,835	2.38%			45,061	2.29%
29	8	2008			2,239	0.56%			43,830	2.32%			46,069	2.24%
30	9	2009			2,251	0.56%			44,826	2.27%			47,077	2.19%
31	10	2010			2,264	0.56%			45,821	2.22%			48,085	2.14%
32	11	2011			2,276	0.55%			46,817	2.17%			49,093	2.10%
33	12	2012			2,289	0.55%			47,812	2.13%			50,101	2.05%
34	13	2013			2,302	0.55%			48,808	2.08%			51,109	2.01%
35	14	2014			2,314	0.54%			49,803	2.04%			52,117	1.97%
36	15	2015			2,327	0.54%			50,799	2.00%			53,125	1.93%
37	16	2016			2,339	0.54%			51,794	1.96%			54,133	1.90%
38	17	2017			2,352	0.54%			52,790	1.92%			55,142	1.86%
39	18	2018			2,364	0.53%			53,785	1.89%			56,150	1.83%
40	19	2019			2,377	0.53%			54,781	1.85%			57,158	1.80%
41	20	2020			2,389	0.53%			55,776	1.82%			58,166	1.76%
42	21	2021			2,402	0.52%			56,772	1.78%			59,174	1.73%
43	22	2022			2,414	0.52%			57,767	1.75%			60,182	1.70%
44	23	2023			2,427	0.52%			58,763	1.72%			61,190	1.68%
45	24	2024			2,439	0.52%			59,758	1.69%			62,198	1.65%
46	25	2025			2,452	0.51%			60,754	1.67%			63,206	1.62%
47	26	2026			2,465	0.51%			61,750	1.64%			64,214	1.59%
48	27	2027			2,477	0.51%			62,745	1.61%			65,222	1.57%
49	28	2028			2,490	0.51%			63,741	1.59%			66,230	1.55%
50	29	2029			2,502	0.50%			64,736	1.56%			67,238	1.52%
51	30	2030			2,515	0.50%			65,732	1.54%			68,246	1.50%
Average annual future percentage change=						**0.54%**				**2.01%**				**1.95%**

D. REGRESSION OUTPUT
Future CAHC Scenario#2

A. Solvents 1970,1980-96:	
Constant	-22945.5
Std Err of Y Est	171.2
R Squared	0.193
No. of Observations	18
Degrees of Freedom	16
X Coefficient(s)	12.5
Std Err of Coef.	6.4
B. Plastics 1970,1980-96:	
Constant	-1955179
Std Err of Y Est	2825.8
R Squared	0.847
No. of Observations	18
Degrees of Freedom	16
X Coefficient(s)	995.5
Std Err of Coef.	105.8
C. Total (A+B) 1970,1980-96:	
Constant	-1978124
Std Err of Y Est	2901.5
R Squared	0.843
No. of Observations	18
Degrees of Freedom	16
X Coefficient(s)	1008.1
Std Err of Coef.	108.6

EXHIBIT E-3

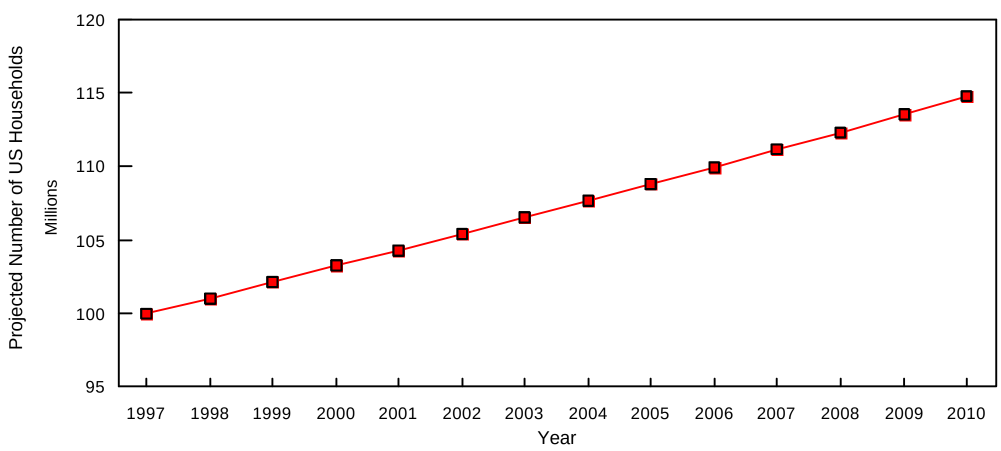
CAHC LISTING PROPOSAL:
Data Basis for "Scenario#3"
Future Compliance Cost Stream
Number of US Households 1997-2010

Data Item	Year	US Census Forecasted Number of US Households	Annual Percent Change
1	1997	99,965,000	
2	1998	101,043,000	1.08%
3	1999	102,119,000	1.06%
4	2000	103,246,000	1.10%
5	2001	104,344,000	1.06%
6	2002	105,456,000	1.07%
7	2003	106,566,000	1.05%
8	2004	107,673,000	1.04%
9	2005	108,819,000	1.06%
10	2006	109,982,000	1.07%
11	2007	111,162,000	1.07%
12	2008	112,363,000	1.08%
13	2009	113,568,000	1.07%
14	2010	114,825,000	1.11%
Average annual % change =			**1.07%**

Source: US Bureau of the Census, April 1996;
Current Population Reports No. P25-1129,
Table C, "Series 1" projection, p5.
(http://www.census.gov/prod/www/abs/ap251129.html).

BUREAU OF CENSUS PROJECTION OF US HOUSEHOLDS

Annual Increase in Number of Households 1997-2010



Source: US Bureau of Census, "Current Population Reports", Nr.P25-1129, April 1996, p.5.

EXHIBIT E-4

CHLORINATED ALIPHATIC HYDROCARBON COMPOUNDS (CAHCs)
THREE ALTERNATIVE US CAHC PRODUCTION GROWTH SCENARIOS FOR THE 30-YEAR POA
(million pounds 2001-2030)

Item	30-year future POA	Year	A. CAHC SOLVENTS Scenario#2 (regression)	Scenario#3 1.07%	B. CAHC PLASTICS Scenario#2 (regression)	Scenario#3 1.07%	C. TOTAL CAHC (A+B) Scenario#2 (regression)	Scenario#3 1.07%	Scenario#4 -1.00%	Annual Percent Change Scenario#2	Annual Percent Change Scenario#3	Annual Percent Change Scenario#4
1	-5	1996	**2,088**		**31,884**		**33,972**			NR	NR	NR
2	-4	1997	2,101	2,111	32,879	32,226	34,980	34,336	33,632	2.97%	1.07%	-1.00%
3	-3	1998	2,113	2,123	33,875	33,232	35,988	34,704	33,296	2.88%	1.07%	-1.00%
4	-2	1999	2,126	2,136	34,870	34,238	36,996	35,076	32,963	2.80%	1.07%	-1.00%
5	-1	2000	2,138	2,149	35,866	35,244	38,004	35,452	32,634	2.72%	1.07%	-1.00%
6	Base=1	2001	2,151	2,161	36,861	36,250	39,013	35,832	32,307	2.65%	1.07%	-1.00%
7	2	2002	2,164	2,174	37,857	37,257	40,021	36,216	31,984	2.58%	1.07%	-1.00%
8	3	2003	2,176	2,187	38,853	38,263	41,029	36,604	31,664	2.52%	1.07%	-1.00%
9	4	2004	2,189	2,199	39,848	39,269	42,037	36,997	31,348	2.46%	1.07%	-1.00%
10	5	2005	2,201	2,212	40,844	40,275	43,045	37,393	31,034	2.40%	1.07%	-1.00%
11	6	2006	2,214	2,225	41,839	41,281	44,053	37,794	30,724	2.34%	1.07%	-1.00%
12	7	2007	2,226	2,237	42,835	42,288	45,061	38,199	30,417	2.29%	1.07%	-1.00%
13	8	2008	2,239	2,250	43,830	43,294	46,069	38,608	30,112	2.24%	1.07%	-1.00%
14	9	2009	2,251	2,263	44,826	44,300	47,077	39,022	29,811	2.19%	1.07%	-1.00%
15	10	2010	2,264	2,275	45,821	45,306	48,085	39,440	29,513	2.14%	1.07%	-1.00%
16	11	2011	2,276	2,288	46,817	46,312	49,093	39,863	29,218	2.10%	1.07%	-1.00%
17	12	2012	2,289	2,301	47,812	47,318	50,101	40,290	28,926	2.05%	1.07%	-1.00%
18	13	2013	2,302	2,314	48,808	48,325	51,109	40,722	28,637	2.01%	1.07%	-1.00%
19	14	2014	2,314	2,326	49,803	49,331	52,117	41,159	28,350	1.97%	1.07%	-1.00%
20	15	2015	2,327	2,339	50,799	50,337	53,125	41,600	28,067	1.93%	1.07%	-1.00%
21	16	2016	2,339	2,352	51,794	51,343	54,133	42,046	27,786	1.90%	1.07%	-1.00%
22	17	2017	2,352	2,364	52,790	52,349	55,142	42,496	27,508	1.86%	1.07%	-1.00%
23	18	2018	2,364	2,377	53,785	53,356	56,150	42,952	27,233	1.83%	1.07%	-1.00%
24	19	2019	2,377	2,390	54,781	54,362	57,158	43,412	26,961	1.80%	1.07%	-1.00%
25	20	2020	2,389	2,402	55,776	55,368	58,166	43,877	26,691	1.76%	1.07%	-1.00%
26	21	2021	2,402	2,415	56,772	56,374	59,174	44,348	26,424	1.73%	1.07%	-1.00%
27	22	2022	2,414	2,428	57,767	57,380	60,182	44,823	26,160	1.70%	1.07%	-1.00%
28	23	2023	2,427	2,440	58,763	58,387	61,190	45,303	25,898	1.68%	1.07%	-1.00%
29	24	2024	2,439	2,453	59,758	59,393	62,198	45,789	25,639	1.65%	1.07%	-1.00%
30	25	2025	2,452	2,466	60,754	60,399	63,206	46,280	25,383	1.62%	1.07%	-1.00%
31	26	2026	2,465	2,478	61,750	61,405	64,214	46,776	25,129	1.59%	1.07%	-1.00%
32	27	2027	2,477	2,491	62,745	62,411	65,222	47,277	24,878	1.57%	1.07%	-1.00%
33	28	2028	2,490	2,504	63,741	63,418	66,230	47,784	24,629	1.55%	1.07%	-1.00%
34	29	2029	2,502	2,516	64,736	64,424	67,238	48,296	24,383	1.52%	1.07%	-1.00%
35	30	2030	2,515	2,529	65,732	65,430	68,246	48,813	24,139	1.50%	1.07%	-1.00%
Explanatory Notes:			Average annual percent change over POA =							**1.95%**	**1.07%**	**-1.00%**

(a) The shaded cells in the two right-most columns above, which correspond to the reference growth period (POA), are applied as two alternative scenarios for estimating future industry compliance costs for the RCRA listing proposal.
(b) Not shown above is "Scenario#1", which represents simple scenario of constant future stream of listing compliance costs.
(c) The "Scenario#4" annual rate factor of -1.0% is also displayed above, for purpose of illustrating one hypothetical interpretation of that scenario.

EXHIBIT E-5

NON-CONSTANT ANNUAL INDUSTRY COMPLIANCE COSTS (AT CONSTANT 1996$)

CHLORINATED ALIPHATIC HYDROCARBON COMPOUNDS (CAHCs)

ESTIMATION OF INDUSTRY COMPLIANCE COSTS FOR THE RCRA LISTING PROPOSAL

THREE ALTERNATIVE FUTURE ANNUAL COST STREAMS (SC

					Scenario#1	A. ANNUAL PERCENTAGE CHANGE			B. NON-CONSTANT COST STREAMS		
	Row Item	30-yr base period	POA discount reference year	Calendar Year	Constant annual industry cost ($millions)	Scenario#2 CAHC historical growth rate	Scenario#3 Census household growth rate	Scenario#4 Bounded average decline rate	Scenario#2 CAHC historical growth ($millions)	Scenario#3 Census household growth ($millions)	Scenario#4 Bounded average decline ($millions)
Study>	1	-2		1999	**$2.355**				**$2.355**	**$2.355**	**$2.355**
	2	-1		2000	$2.355	2.72%	1.07%	-1.90%	$2.419	$2.380	$2.310
Base>	3	1	0	2001	$2.355	2.65%	1.07%	-1.86%	$2.483	$2.406	$2.267
	4	2	1	2002	$2.355	2.58%	1.07%	-1.83%	$2.548	$2.432	$2.226
	5	3	2	2003	$2.355	2.52%	1.07%	-1.80%	$2.612	$2.458	$2.186
	6	4	3	2004	$2.355	2.46%	1.07%	-1.76%	$2.676	$2.484	$2.147
	7	5	4	2005	$2.355	2.40%	1.07%	-1.73%	$2.740	$2.511	$2.110
	8	6	5	2006	$2.355	2.34%	1.07%	-1.71%	$2.804	$2.537	$2.074
	9	7	6	2007	$2.355	2.29%	1.07%	-1.68%	$2.868	$2.565	$2.039
	10	8	7	2008	$2.355	2.24%	1.07%	-1.65%	$2.933	$2.592	$2.005
	11	9	8	2009	$2.355	2.19%	1.07%	-1.63%	$2.997	$2.620	$1.973
	12	10	9	2010	$2.355	2.14%	1.07%	-1.61%	$3.061	$2.648	$1.941
	13	11	10	2011	$2.355	2.10%	1.07%	-1.58%	$3.125	$2.676	$1.910
	14	12	11	2012	$2.355	2.05%	1.07%	-1.56%	$3.189	$2.705	$1.880
	15	13	12	2013	$2.355	2.01%	1.07%	-1.54%	$3.253	$2.734	$1.851
	16	14	13	2014	$2.355	1.97%	1.07%	-1.52%	$3.318	$2.763	$1.823
	17	15	14	2015	$2.355	1.93%	1.07%	-1.50%	$3.382	$2.793	$1.796
	18	16	15	2016	$2.355	1.90%	1.07%	-1.48%	$3.446	$2.823	$1.769
	19	17	16	2017	$2.355	1.86%	1.07%	-1.47%	$3.510	$2.853	$1.743
	20	18	17	2018	$2.355	1.83%	1.07%	-1.45%	$3.574	$2.884	$1.718
	21	19	18	2019	$2.355	1.80%	1.07%	-1.43%	$3.638	$2.915	$1.693
	22	20	19	2020	$2.355	1.76%	1.07%	-1.42%	$3.703	$2.946	$1.669
	23	21	20	2021	$2.355	1.73%	1.07%	-1.40%	$3.767	$2.977	$1.646
	24	22	21	2022	$2.355	1.70%	1.07%	-1.39%	$3.831	$3.009	$1.623
	25	23	22	2023	$2.355	1.68%	1.07%	-1.37%	$3.895	$3.042	$1.601
	26	24	23	2024	$2.355	1.65%	1.07%	-1.36%	$3.959	$3.074	$1.579
	27	25	24	2025	$2.355	1.62%	1.07%	-1.35%	$4.023	$3.107	$1.558
	28	26	25	2026	$2.355	1.59%	1.07%	-1.33%	$4.088	$3.140	$1.537
	29	27	26	2027	$2.355	1.57%	1.07%	-1.32%	$4.152	$3.174	$1.517
	30	28	27	2028	$2.355	1.55%	1.07%	-1.31%	$4.216	$3.208	$1.497
	31	29	28	2029	$2.355	1.52%	1.07%	-1.30%	$4.280	$3.243	$1.477
	32	30	29	2030	$2.355	1.50%	1.07%	-1.29%	$4.344	$3.277	$1.458
Summary:		Avg annual % change=				**1.95%**	**1.07%**	**-1.51%**			
Base Period Present value=				0.0%					$102.413	$84.597	$54.317
Average annual equivalent=									$3.414	$2.820	$1.811
			PV=	3.0%					$64.162	$53.991	$36.678
			AAE=						$3.274	$2.755	$1.871
			PV=	5.0%					$48.995	$41.732	$29.352
			AAE=						$3.187	$2.715	$1.909
			PV=	7.0%					$38.578	$33.241	$24.130
			AAE=						$3.109	$2.679	$1.945
			PV=	10.0%					$28.356	$24.819	$18.766
			AAE=						$3.008	$2.633	$1.991

Explanatory Notes:

(a) Three alternative future annual percentage growth scenarios displayed in shaded columns above derived from two alternative (
Scenario#2: Historical trend projection based on extrapolation of annual percentage growth, using a linear regression of US CAH
Scenario#3: Based on extrapolation of the annual percentage growth rate for US households of 1.07% projected by the US Bur
Scenario#4: Illustrative hypothetical decline in future US CAHC production for scenario bounding purposes in this study.

ATTACHMENT F:

US CHEMICAL INDUSTRY SALES AND PROFIT PERFORMANCE DATA (1992-1998)

EXHIBIT F-1:

INDUSTRY SALES AND PROFIT PERFORMANCE (1992-1998)
SIC codes = 281 + 282 + 286 (Industrial Chemicals & Synthetics).
Source: "Quarterly Financial Reports", US Bureau of the Census.
http://www.census.gov/csd/qfr/view/

				A. SALES REVENUES		B. AFTER-TAX PROFIT		C. PROFIT PERCENT	
Nr. of data years	Nr. of data quar-ters	Year	Qrtr	Quarterly Sales Revenues ($millions)	Annual Sales Revenues ($millions)	Quarterly After-Tax Profit ($millions)	Annual After-Tax Profit ($millions)	Quarterly After-Tax Profit as % of Sales	Annual After-Tax Profit as % of Sales
1	1	1998	4Q	$35,199	$146,511	$1,006	$7,931	2.9%	5.4%
	2	1998	3Q	$36,325		$1,388		3.8%	
	3	1998	2Q	$38,086		$2,800		7.4%	
	4	1998	1Q	$36,901		$2,737		7.4%	
2	5	1997	4Q	$38,981	$166,300	($88)	$9,594	-0.2%	5.8%
	6	1997	3Q	$41,730		$2,174		5.2%	
	7	1997	2Q	$43,536		$3,987		9.2%	
	8	1997	1Q	$42,053		$3,521		8.4%	
3	9	1996	4Q	$40,158	$162,486	$1,858	$8,480	4.6%	5.2%
	10	1996	3Q	$41,256		$3,402		8.2%	
	11	1996	2Q	$42,426		($226)		-0.5%	
	12	1996	1Q	$38,646		$3,446		8.9%	
4	13	1995	4Q	$38,252	$156,659	$810	$11,046	2.1%	7.1%
	14	1995	3Q	$38,413		$2,659		6.9%	
	15	1995	2Q	$40,699		$4,003		9.8%	
	16	1995	1Q	$39,295		$3,574		9.1%	
5	17	1994	4Q	$36,927	$140,447	$1,694	$8,418	4.6%	6.0%
	18	1994	3Q	$35,122		$2,504		7.1%	
	19	1994	2Q	$35,320		$2,121		6.0%	
	20	1994	1Q	$33,078		$2,099		6.3%	
6	21	1993	4Q	$30,533	$122,667	$382	$4,081	1.3%	3.3%
	22	1993	3Q	$30,608		$99		0.3%	
	23	1993	2Q	$31,592		$2,037		6.4%	
	24	1993	1Q	$29,934		$1,563		5.2%	
7	25	1992	4Q	$30,657	$122,545	($372)	($2,582)	-1.2%	-2.1%
	26	1992	3Q	$30,996		$1,599		5.2%	
	27	1992	2Q	$31,105		$1,965		6.3%	
	28	1992	1Q	$29,787		($5,774)		-19.4%	
Summary Statistics:									
Minimum				$29,787	$122,545	($5,774)	($2,582)	-19.38%	-2.11%
Mean				$36,343	$145,374	$1,677	$6,710	4.33%	**4.38%**
Median				$36,914	$146,511	$2,001	$8,418	5.61%	5.41%
Maximum				$43,536	$166,300	$4,003	$11,046	9.84%	7.05%
Range interval (max-min)				$13,749	$43,755	$9,777	$13,628	29.22%	9.16%
Standard deviation				$4,375	$17,890	$1,931	$4,617	5.61%	3.07%
Kurtosis				-1.29	-1.42	5.95	0.40	9.47	1.01
Skewness				-0.13	-0.25	-2.04	-1.28	-2.80	-1.53

EXHIBIT F-2

PROFITS
USEPA-OSW 1999 CHLORINATED ALIPHATIC HYDROCARBON LISTING PROPOSAL
ESTIMATION OF EDC/VCM PRODUCTION PROFITS PER US FACILITY

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Item	EDC/VCM Producer Facility Name	Facility City	State	Annual EDC capacity* (mill lbs)	Annual VCM capacity* (mill lbs)	Annual final actual production** (mill lbs)	(metric tons)	Annual market value (sales revenue)*** (mill $)	Annual after-tax profits**** (mill $)	Annual EDC+VCM sludge (metric tons)	Ratio sludge to final product	Annual EDC+VCM wastewaters (metric tons)	Ratio WW to final product
1	Borden Chemicals & Plastics	Geismar	LA	745	950	818	371,127	$177.956	$9.627	311.0	0.0148%	763,200	36.4%
2	Condea Vista	Lake Charles	LA	1,400	850	732	332,061	$159.224	$8.614	2.7	0.0001%	466,024	24.9%
3	Dow Chemicals	Freeport	TX	4,500	2,200	1,895	859,453	$412.108	$22.295	216.0	0.0045%	667,200	13.8%
?4	Dow Chemicals	Oyster Creek	TX	0	900	775	351,594	$168.590	$9.121	????	????	????	????
5	Dow Chemicals	Plaquemine	LA	2,300	1,500	1,292	585,991	$280.983	$15.201	96.0	0.0029%	1,882,830	56.9%
6	Formosa Plastics Corp	Baton Rouge	LA	525	1,455	1,253	568,411	$272.553	$14.745	107.0	0.0033%	831,249	25.9%
7	Formosa Plastics Corp	Point Comfort	TX	1,900	875	754	341,828	$163.907	$8.867	284.0	0.0147%	898,590	46.6%
8	Geon Company	LaPorte	TX	4,000	1,650	1,421	644,590	$309.081	$16.721	1,804.0	0.0496%	962,950	26.5%
9	Georgia Gulf Corp.	Plaquemine	LA	1,760	1,600	1,378	625,057	$299.715	$16.215	624.0	0.0177%	1,254,141	35.6%
10	Occidental (Oxy) Chemical	Convent	LA	1,500	0	1,292	585,991	$219.619	$11.881	500.0	0.0151%	223,000	6.7%
11	Occidental (Oxy) Chemical	Ingleside (Gregory)	TX	1,500	0	1,292	585,991	$219.619	$11.881	160.0	0.0048%	????	????
12	Occidental (Oxy) Chemical	Deer Park	TX	1,950	1,100	947	429,726	$206.054	$11.148	442.0	0.0182%	695,253	28.7%
13	Oxymar (JV of OxyChem & Marubeni Corp)	Ingleside (Gregory)	TX	3,000	2,100	1,809	820,387	$393.376	$21.282	1,445.0	0.0312%	????	????
??14	PHH Monomers (JV of PPG & Condea Vista)	Lake Charles	LA	1,400	1,150	990	449,260	$215.420	$11.654	????	????	????	????
15	PPG Industries	Lake Charles	LA	1,600	0	1,378	625,057	$234.260	$12.673	581.0	0.0165%	1,636,617	46.4%
16	Vulcan Chemicals	Geismar	LA	500	0	431	195,330	$73.206	$3.960	0.0	0.0000%	????	0.0%
17	Westlake Monomers	Calvert City	KY	1,950	1,200	1,034	468,793	$224.786	$12.161	0.0	0.0000%	298,000	11.3%
	Column Totals=			**30,530**	**17,530**	**19,490**	**8,840,646**	**$4,030.456**	**$218.048**	**6,572.7**	**0.0145%**	**10,579,054**	**28.3%**

Explanatory Notes:

(a) * EDC & VCM annual production capacity source: ChemExpo Chemical Profiles, Feb 1998 (http://www.chemexpo.com/news/).

(b) ** Final production represents estimated final output for market sale, excluding EDC simply assumed used 100% (actual=98%) captively for production of VCM in the US.
Actual production estimated as percentage of annual capacity (1990-1997 average of SIC 282 plastics & 286 industrial organic chems) = **86%**
source: US Dept of Commerce Bureau of Census, "Current Industrial Reports: Survey of Plant Capacity" (refer to companion spreadsheet in this file for supporting capacity utilization data).

(c) ?4 = Dow Oyster Creek VCM facility reported at http://it.stlawu.edu/wastenot/314feb95.html; not included in OSW's 1999 listing proposal master list of 15 facilities.

(d) ??14 = PHH Monomers facility reported at http://www.chemexpo.com/news/, but not included in OSW's 1999 listing proposal master list of 15 facilities.

(e) *** Market value estimated using either the Feb 1998 US average EDC sales price ($0.1700/lb) or VCM sales price ($0.2175/lb); source: http://www.chemexpo.com/news/

(f) **** Average after-tax profit as percent of sales revenue applied as estimator above, represents US Census Bureau data median over 1992-1998 for SIC 281 & 282 & 286 = **5.41%**

(g) JV= joint venture business partnership.

(h) Metric ton = 1,000 kilograms = 2,204.6 pounds = 1.1023 short tons (1.0 short ton = 2,000 pounds).

(i) F:\USER\MEADS\PROJECTS\CHLORALP\ECONWORK\PROFITS.WK4 OSW-EMRAD 07/29/99

EXHIBIT F-3

USEPA-OSW 1999 CHLORINATED ALIPHATIC HYDROCARBON LISTING PROPOSAL ANNUAL CAPACITY UTILIZATION RATES IN TWO US CHEMICAL INDUSTRY SECTORS, AS A PERCENTAGE OF INSTALLED FULL PRODUCTION CAPACITY*

Data item	Calendar Year	SIC 282 Plastics & Synthetic Chemicals	SIC 286 Industrial Organic Chemicals	Average of Chemical Industry SICs 282 & 286
8	1997	89%	79%	84%
7	1996	86%	85%	86%
6	1995	86%	84%	85%
5	1994	87%	89%	88%
4	1993	85%	90%	88%
3	1992	86%	82%	84%
2	1991	87%	86%	87%
1	1990	93%	84%	89%

Trend Summary Statistics:

	SIC 282	SIC 286	Average
Mean=	87.4%	84.9%	**86.1%**
Median=	86.5%	84.5%	86.0%
Standard deviation=	2.6%	3.6%	1.8%

Explanatory Notes: OSW-EMRAD 07/29/99

(a) * Full production defined as the maximum level of production under normal operating conditions.

(b) Data sources: Following reports from the US Dept of Commerce, Bureau of the Census:
1997 data: "Current Industrial Reports: Survey of Plant Capacity: 1997", MQ-C1(97), March 1999.
1991-1996 data: "Current Industrial Reports: Survey of Plant Capacity: 1996", MQ-C1(96), April 1998.
1990 data: "Current Industrial Reports: Survey of Plant Capacity: 1994", MQ-C1(94), Sept 1996.
(Refer to website: <<http://www.census.gov/prod/www/abs/plant.html>> for above reports.)

(c) Trend mean percentage in shaded boldface cell above, used as input into estimation of EDC/VCM producer per-facility profits (refer to companion spreadsheet in this file).

(d) F:\USER\MEADS\PROJECTS\CHLORALP\ECONWORK\PROFITS.WK4

EXHIBIT F-4

CHLORINATED ALIPHATIC HYDROCARBON COMPOUNDS (CAHCs)
ESTIMATION OF US MARKET VALUE OF CAHC PRODUCTION

Item	CAHC Chemical Name	1994 USITC US annual production (mill.lbs)	1994 USITC US average price ($/lb)	1994 market value ($million)
A. Chlorinated only:				
1	Chloromethane (methyl chloride)	998.4	$0.25	$249.6
2	Dichloromethane (methylene chloride)	403.0	$0.17	$68.5
3	Trichloromethane (chloroform)	497.1	$0.19	$94.4
4	1,2-dichloroethane (ethylene dichloride)**	16,744.0	$0.10	$1,674.4
5	Tetrachloroethane (perchloroethylene)	246.7	$0.33	$81.4
6	Trichloronitromethane (chloropicrin)	6.9	$0.96	$6.6
7	Chloroethylene (vinyl chloride)	13,836.0	$0.21	$2,905.6
8	1,1-dichloroethylene (vinylidene chloride)	161.7	$0.43	$69.5
	A subtotals & average price>	32,893.8	$0.33	$5,150
B. Chlorinated with other halogens:				
9	Chlorodifluoromethane	304.4	$1.07	$325.7
10	Dichlorodifluoromethane	126.7	$2.05	$259.7
11	Trichlorofluoromethane	16.1	$1.45	$23.3
12	Trichlorotrifluoroethane	271.6	$1.65	$448.1
13	Other chlorinated aliphatics not above	910.7	$1.56	$1,416.1
	B subtotals & average price>	1,629.5	$1.56	$2,473
C. ESTIMATE OF TOTAL PRODUCTION & MARKET VALUE:				
	Quantity and "in situ" value (column totals)=	34,523		$7,623
	Final market value (w/out EDC**) =			$5,949
D. ESTIMATE IF 1994 SCALED TO 1997 PRODUCTION:*				
	1997 estimated quantity and final value**>	38,800		**$6,686**

E. EXPLANATORY NOTES:

(a) Source: US International Trade Commission, "Synthetic Organic Chemicals: US Production and Sales 1994", USITC report nr. 2933, Nov 1995.

(b) 29 CAHCs listed in the USITC source, but only above 13 have quantity/price data.

(c) * 1997 volume estimated from ChemExpo website, and by applying Dept of Commerce 1997 industry capacity utilization rate.

(d) Missing data in price column shaded cells, assigned average class price.

(e) ** Because up to 98% of ethylene dichloride (EDC) is reportedly used as a feedstock for the production of vinyl chloride, its value is subtracted from final value estimate.

ATTACHMENT G

SMALL BUSINESS DETERMINATION FOR COMPLIANCE WITH THE REGULATORY FLEXIBILITY ACT OF 1980:

SUPPORTING DATA DOCUMENTATION

EXHIBIT G-1

USEPA'S 1999 RCRA CHLORINATED ALIPHATICS LISTING PROPOSAL: SMALL BUSINESS DETERMINATION USING SBA SIZE STANDARDS FOR RFA* COMPLIANCE
COMPANY NUMBER OF EMPLOYEES & ANNUAL SALES REVENUES (COMPANIES LISTED ALPHABETICALLY BELOW)

Item	Chlorinated Aliphatics Producers Company Name (Subsidiary)	Number chlorinated aliphatic facilities in USA	US-SEC Form 10-K report** filing date	Company data reference fiscal year	Company primary 4-digit SIC code	State of US incorp-oration	Company's principal executive office location	A. EMPLOYEE TEST: Company total full-time employees	SBA "small business" threshold employees	Ratio actual to SBA's	B. SALES TEST: Company sales revenues*** (US$1000s)	SBA "small business" threshold ($1000s)	Ratio actual to SBA's	Company capital expenditures (1000s)	Captl. expndtrs as % of sales revenues	Company net income (after-tax profit) (1000s)	Net income as % of sales revenues	Company available credit facilities**** (1000s)	Credit as % of sales revenues
1	Borden Chemicals & Plastics Ltd	1	03/1998	1997	2821	DE	Geismar, LA	800	750	1.1	$737,100			$19,400	2.6%	$5,600	0.8%	$100,000	13.6%
2	Dow Chemical Company	2	03/1998	1997	2800	DE	Midland, MI	42,861	1,000	43	$20,018,000			$1,198,000	6.0%	$1,802,000	9.0%	$1,825,000	9.1%
3	Dow Corning Corp.	2	02/1995	1994	2821	MI	Midland, MI	8,300	750	11	$2,204,600			$177,600	8.1%	($6,800)	-0.3%	$375,000	17.0%
4	DuPont E.I. de Nemours & Company	2	03/1998	1997	2821	DE	Wilmington, DE	98,000	750	131	$45,079,000			$8,300,000	18.4%	$2,405,000	5.3%	$2,800,000	6.2%
	(Chemical Segment: incl. DuPont-Dow Elastomers) + +				2822			3,300	1,000	3	$4,267,000			$338,000	7.9%	???	???	???	???
5	FMC Corp.	1	03/1998	1997	2812	DE	Chicago, IL	16,805	1,000	17	$4,259,000			$316,700	7.4%	$162,000	3.8%	$750,000	17.6%
	(Performance Chemicals Div.)				2812			???	1,000	???	$1,242,200			$129,200	10.4%	$112,300	9.0%	???	???
6	Formosa Plastics Corp. USA*****	2	None	1997	2821	???	Livingston, NJ	3,000	750	4	$1,500,000			???	???	???	???	???	???
7	General Electric Company	1	03/1998	1997	3600	NY	Fairfield, CT	276,000	1,000	276	$40,675,000			$39,365,000	96.8%	$8,203,000	20.2%	$3,629,000	8.9%
	(Materials Division)				???			???	???	???	$6,695,000			???	???	$1,476,000	22.0%	???	???
8	Geon Company	1	03/1998	1997	2821	DE	Avon Lake, OH	2,000	750	3	$1,250,000			$50,900	4.1%	$22,500	1.8%	$193,000	15.4%
9	Georgia Gulf Corp.	1	03/1997	1996	2810	DE	Atlanta, GA	1,030	1,000	1.03	$896,200			$177,000	19.8%	$71,600	8.0%	$49,400	5.5%
10	Occidental Petroleum Corp.	3	03/1999	1998	1311	DE	Los Angeles, CA	9,190	500	18	$6,596,000			$1,074,000	16.3%	$363,000	5.5%	$1,500,000	22.7%
	(Occdntl. Chemical Corp. "Oxymar")				2800			5,850	1,000	6	$2,975,000			$321,000	10.8%	$266,000	8.9%	???	0.0%
11	PPG Industries Inc.	1	02/1999	1998	2851	PA	Pittsburg, PA	32,500	500	65	$7,510,000			$877,000	11.7%	$801,000	10.7%	$748,000	10.0%
12	RWE-DEA Chemicals	1	None	1998	2800	???	Hamburg, Germany	8,900	1,000	9	$1,921,000			???	???	???	???	???	???
	(Condea Vista Company*****)		None		2800		Houston, TX	1,400	1,000	1.4	???			???	???	???	???	???	???
13	Shell Petroleum Company	1	03/1998	1997	2911	DE	Houston, TX	19,904	1,500	13	$28,959,000			$3,131,000	10.8%	$2,104,000	7.3%	$342,000	1.2%
	(Shell Chemical Products Division)				2800			???	1,000	???	$4,725,000			$348,000	7.4%	$457,000	9.7%	???	0.0%
14	True Speciality Chemicals Corp.	1	None	1998	2869	???	DesPlaines, IL	600	1,000	0.6	$200,000			???	???	???	???	???	???
	(Velsicol Chemical Corp.*****)		None	1998	2869		Rosemont, IL	600	1,000	0.6	$200,000			???	???	???	???	???	???
15	Vulcan Materials Company	2	03/1998	1997	1400	NJ	Birmingham, AL	5,399	See sales	(J41/ K41)	$1,678,600	$500,000	3.4	$173,300	10.3%	$213,400	12.7%	$130,000	7.7%
	(Chemicals Segment)				2800			1,619	1,000	1.6	$627,600			???	???	???	???	???	???
16	Westlake Group*****	1	None	1998	2295	???	Houston TX	1,445	1,000	1.4	$191,700			???	???	???	???	???	???
	(Westlake Monomers Corp.*****)		None		2821		Calvert City, KY	190	750	0.3	???			???	???	???	???	???	???
Summary of Company Data Above:																			
	Column means (non-duplicative+) =	1.4						32,921			$10,230,000			$4,572,000	44.7%	$1,346,000	13.2%	$1,037,000	10.1%
	Column medians (non-duplicative+) =	1.0						8,600			$2,062,800			$177,300	8.6%	$116,800	5.7%	$267,500	13.0%
	Column totals (non-duplicative+) =	23						526,734			$163,675,200			$54,859,900	33.5%	$16,146,300	9.9%	$12,441,400	7.6%
Totals with Imputed Missing Company Data: + + +								Same			Same			**$55,569,100**	34.0%	**$16,613,500**	10.2%	**$13,511,400**	8.3%

Explanatory Notes:

(a) **CONCLUSION: Based on applying the unique SBA small business employee size standard for each SIC code, only one of the parent companies (row item #14) may be classified as a "small business".**

(b) Data source: US Securities & Exchange Commission (SEC) website <http://www.sec.gov/Archives/edgar/data/>

(c) * RFA = Regulatory Flexibility Act of 1980 (as amended in 1996 by the SBREFA); see text of the Economics Background Document for explanation of RFA regulatory analysis requirements.

(d) Shaded columns above: SBA "size standards" tests for definition of small business: (#1) usually if <500 parent company total employees, or (#2) usually if <$5 million in parent company annual sales revenues (for all domestic and foreign affiliates).
However SBA size standards vary by industry; the SBA provides unique size standard by four-digit SIC code which are applied above (source: <http:// www.sba.gov/regulations/siccodes/>).
For additional information about small business "size standards", visit the US Small Business Administration's website: <http://www.sba.gov/size/>, or see "13 CFR Part 121", or the Federal Register, Vol.61, No.21, 31 Jan 1996, pp.3280-3304.
The SBA publishes annually in the Federal Register, its small business size standard tables according to four-digit SIC codes.
This conclusion also applies even to SBA's generalized sales test threshold of $5 million in annual company revenues (because employees generally applied above as test, only one year, not three-year average revenue data collected per the RFA).

(e) ** "Form 10-K" is an annual report which most companies supply to the SEC; it presents a comprehensive overview of the business operations and financial conditions of a company.

(f) *** Companies may also earn other types of revenues in addition to sales revenues (e.g. General Electric Co.); net income and capital expenditures shown may correspond to the larger company revenue base in such cases.

(g) ****Available credit facilities = working capital and/or revolving credit (internal company sources and/or external borrowing sources within the US or abroad).
Credit facilities may include short-term debt supplied by unsecured financial instruments at variable borrowing interest rates, or highly liquid investment cash equivalents.

(h) ***** Financial data and number of employees for these companies are not available from the US-SEC "EDGAR" database because they are privately-held companies not required to register business information with the US-SEC;
OSW-EMRAD attempted to collect business data for privately-held companies from (a) company internet websites, or (b) company telephone contacts listed below:

Formosa Plastics Corp. USA: <http://www.fpcusa.com/>.	RWE-DEA Chemicals: <http://www.condea.com/overview.html>
Westlake Group: Chris Gaines, Envir.Reg.Affairs, 713-585-2816.	Velsicol Chem. Corp.: <http://www.velsicol.com/index.html>, & Patrick Kitchens, Dir.Env.Health & Safety, 847-635-3421.

(i) + Non-duplicative column totals and averages exclude the company subsidiary information row items (which are already included (rolled-up) in the parent company row items).

(j) + + DuPont-Dow Elastomers is a 50%/50% joint venture by the two companies formed in 1997 (source: DuPont's March 1998 annual 10-K report).

(k) + + + Imputed totals based on assigning the median value of companies with data, to the missing data for four companies listed above (refer to companion spreadsheet for display of imputed data).

(l) The SBA does not assign an employee threshold to 2-digit SIC codes; for the 2-digit codes above (e.g. 2800), OSW-EMRAD assigned the largest 4-digit level employees within the 2-digit sector.

(m) For purpose of a broader reference comparison, the 1998 top USA leading companies by sales revenues and profits are ("Business Week" magazine, 01 March 1999, p.72):

	Company Name	1998 Sales Revenues (millions)		Company Name	1998 Net income (after-tax "profits" or "earnings" in millions)
Top #1 =	General Motors	$161,315	Top #1 =	Ford Motor Company	$22,071
Top #25 =	American International Group Inc.	$30,847	Top #25 =	Johnson & Johnson	$3,059

(n) Foreign currency exchange rates applied (foreign units per dollar, March 1999): German marks = 1.77 CAP. EXPEND. PROFITS CREDIT

(o) Standard deviations used for imputation of totals:	$11,204,900	$2,333,000	$1,173,100

EXHIBIT G-2

USEPA'S 1999 RCRA CHLORINATED ALIPHATICS LISTING PROPOSAL
COMPANY NUMBER OF EMPLOYEES & ANNUAL FINANCIAL STATUS INDICATORS (BENCHMARKS),
AND ESTIMATION OF TOTALS FOR ALL COMPANIES BY ASSIGNING MEDIAN VALUES TO MISSING DATA CELLS:

ITEM	PARENT COMPANY NAME	Number of Company Employees	Annual Sales Revenues (1000s)	Annual Capital Expenditures (1000s)	Annual Net Profits (1000s)	Short-term Credity Availability (1000s)
1	Borden Chemicals & Plastics Ltd	800	$737,100	$19,400	$5,600	$100,000
2	Dow Chemical Company	42,861	$20,018,000	$1,198,000	$1,802,000	$1,825,000
3	Dow Corning Corp.	8,300	$2,204,600	$177,600	($6,800)	$375,000
4	DuPont E.I. de Nemours & Company	98,000	$45,079,000	$8,300,000	$2,405,000	$2,800,000
5	FMC Corp.	16,805	$4,259,000	$316,700	$162,000	$750,000
6	Formosa Plastics Corp. USA*****	3,000	$1,500,000	**$177,300**	**$116,800**	**$267,500**
7	General Electric Company	276,000	$40,675,000	$39,365,000	$8,203,000	$3,629,000
8	Geon Company	2,000	$1,250,000	$50,900	$22,500	$193,000
9	Georgia Gulf Corp.	1,030	$896,200	$177,000	$71,600	$49,400
10	Occidental Petroleum Corp.	9,190	$6,596,000	$1,074,000	$363,000	$1,500,000
11	PPG Industries Inc.	32,500	$7,510,000	$877,000	$801,000	$748,000
12	RWE-DEA Chemicals	8,900	$1,921,000	**$177,300**	**$116,800**	**$267,500**
13	Shell Petroleum Company	19,904	$28,959,000	$3,131,000	$2,104,000	$342,000
14	True Speciality Chemicals Corp.	600	$200,000	**$177,300**	**$116,800**	**$267,500**
15	Vulcan Materials Company	5,399	$1,678,600	$173,300	$213,400	$130,000
16	Westlake Group*****	1,445	$191,700	**$177,300**	**$116,800**	**$267,500**
	IMPUTED TOTALS (n=16 parent companies):	**526,734**	**$163,675,200**	**$55,569,100**	**$16,613,500**	**$13,511,400**

EXPLANATORY NOTES:

(a) Source: Refer to the previous Exhibit in this Attachment (spreadsheet table) for definitions and references for the data above.

(b) Data reference years are generally 1997 or 1998, with two references to 1994 and 1996 company data.

(c) The company data displayed above correspond to the parent companies, not to the subsidiary (or affiliate) companies which may correspond to the actual chlorinated aliphatics facility. Parent company data are displayed rather than facility-specific data, because the Small Business Adminstration defines its size standards in relation to all domestic and foreign affiliates.

(d) Missing data for four companies (boldface cells in row items 6, 12, 14, 16), OSW-EMRAD assigned the median value of capital expenditures, profits, and credit, based on all companies with data shown above, for purpose of estimating totals in each data category, rather than the mean value, because the distribution of values in each data category are highly skewed (i.e. not normally distributed about a mean); assignment of the mean value to missing data for skewed distributions may result in over or under-estimation of totals in each category.

ATTACHMENT H

LIST OF APPLICABLE SIC AND NAICS CODES

EXHIBIT H-1
LIST OF APPLICABLE SIC AND NAICS CODES

Introduction to codes: Beginning 01 January 1999, all documents related to USEPA's regulatory, compliance and enforcement activities including rules, policies, interpretive guidance, and site-specific determinations with broad application, should properly identify the regulated entities, including descriptions that correspond to the applicable SIC codes or NAICS codes (source: 09 October 1998 USEPA memo from Peter D. Robertson, Acting Deputy Administrator of USEPA).

Since its development in the 1930s, the ***Standard Industrial Classification*** (SIC) code system maintained by the US Department of Commerce Bureau of the Census, has been revised periodically to reflect changes in the US economic structure. New industries were added and small, declining industries deleted or combined with other activities. However, the overall structure of the SIC remained essentially unchanged since the 1930s. The SIC system was last revised in 1987.

On April 9, 1997, the Office of Management and Budget announced its decision to adopt the ***North American Industry Classification System*** (NAICS pronounced "nakes") as the industry classification system used by the statistical agencies of the United States. NAICS was developed by the Economic Classification Policy Committee (ECPC), on behalf of the OMB, in cooperation with Statistics Canada, and Mexico's Instituto Nacional de Estadística, Geografía e Informática (INEGI), to provide comparable business and economic statistics across the three countries.

NAICS replaces the SIC code system, and the new NAICS codes are already being implemented by US Federal agencies. NAICS codes are five- and six-digit, whereas SIC codes are mostly two- and four-digit. NAICS recognizes the changing and growing services-based economy of the US and its North American neighbors. NAICS includes 1,170 industries of which 565 are service-based industries. The SIC had 1,004 industries of which 416 were service related industries. Now, 358 new industries are recognized in NAICS, 250 of which are services producing industries. Additional descriptive information and SIC-NAICS conversion tables are available via the Bureau of the Census Internet website: http://www.census.gov/epcd/www/naicsdev.htm .

Summary of Facilities Potentially Affected
by the USEPA's 1999 Chlorinated Aliphatics Manufacturing Waste Listing Proposal
According to Applicable SIC and NAICS Codes

Item	Parent company SIC code	Industry Sector Name	Nr. of US relevant CAHC mfg facilities*	Parent company NAICS code equivalent**
1	1311	Mining: Crude petroleum & natural gas	3	211111
2	1400	Mining: Nonmetallic minerals, except fuels	2	212300
3	2295	Mfctrg: Coated fabrics, not rubberized	1	31332
4	2800	Mfctrg: Chemicals & allied products	3	325000
5	2810	Mfctrg: Chemicals & allied products	1	325000
6	2812	Mfctrg: Alkalies & chlorine mfg	1	325181
7	2821	Mfctrg: Plastics materials & resins	8	325211
8	2851	Mfctrg: Paints & allied products	1	32551
9	2869	Mfctrg: Industrial organic chemicals, nec	1	32511
10	2911	Mfctrg: Petroleum refining	1	32411
11	3600	Mfctrg: Electronic & other electric eqpmt	1	335000
		Total applicable facilities =	23	

Footnotes:

* The number of relevant facilities is based on the (a) type of CAHC products manufactured, (b) types of wastes generated, and (c) baseline waste management practices, in relation to the terms and conditions of the proposed listing options. However, all CAHC manufacturing facilities in each industrial sector code may not be affected by the proposed listing options.

** OSW-EMRAD derived the NAICS code equivalents above from the SIC-to-NAICS conversion tables provided by the US Department of Commerce, Bureau of the Census, at the following website: http://www.census.gov/epcd/www/naicstab.htm . There is no direct match in the SIC-NAICS conversion tables for SIC codes 1400, 2800, 2810, and 3600, so a generalized six-digit NAICS code is provided above for these four cases.